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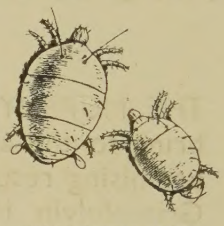

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Fairchild (P. L. K.), Raymond (W. D.) & Spickett (R. G. W.). **Insect Infestation of West African Groundnuts.**—*Colon. Pl. Anim. Prod.* **4** (1954) no. 4 pp. 330–333. London, 1955.

An account is given of experiments in which decorticated groundnuts were artificially infested with *Trogoderma granarium* Everts, *Tribolium castaneum* (Hbst.) or *Pachymerus* (*Caryedon*) *fuscus* (Goeze) and kept for various periods, usually at 30°C. [86°F.] and 70 per cent. relative humidity, to investigate the effect on the amount and quality of the oil and protein content. In the samples originally infested by larvae of *Tribolium*, there was no significant loss in oil content after 8–20 weeks, though the protein content showed a slight progressive decrease with increasing infestation. Similar results were observed after eight weeks in a sample lightly infested with *Trogoderma* larvae. In samples infested with adults of *Tribolium*, there were considerable decreases in protein content after 12–24 weeks, but a significant decrease in oil content only after 24 weeks. The weight of dust passing through a 30-mesh sieve was three times as great in this last sample as in one infested for 12 weeks, and the dust contained a small amount of highly acid oil. In the series infested with adults of *P. fuscus*, the intensity of the original infestation was the same in all samples, but the duration of attack was varied from 9 to 21 weeks. Samples examined after 11 or 21 weeks contained less oil and protein than those examined after 9 weeks, but it appeared that the duration of infestation had little effect on the oil and protein content after an initial critical period of between 9 and 11 weeks. Groundnuts in this series kept for part of the time at 48 per cent. relative humidity yielded more protein and more oil of lower acidity than those kept at 75 per cent. In all cases, the acidity of the extracted oil increased with the extent of infestation, the increase evidently being associated with fragmentation by the insects.

Service and Regulatory Announcements, January–December 1955.—*S.R.A., P.P.C. & P.Q.* no. 184, 103 pp. [Washington, D.C.] U.S. Dep. Agric., 1956.

In addition to announcements relating to quarantines against insect and other pests in the United States, this part includes summaries of the current domestic and foreign plant quarantines of the United States and its Territories and of other restrictive orders under the Plant Quarantine Act [*R.A.E.*, A **17** 163] and of plant-quarantine import restrictions in other countries. Revised summaries of these restrictions are presented for the Belgian Congo, Canada, Denmark, Syria, and Trinidad and Tobago, and supplements to earlier summaries are given for Argentina [**37** 108], Federal Germany [**44** 401], the Republic of Ireland [**44** 401, etc.], Italy [**44** 401] and Uruguay [**29** 499; **36** 105, etc.].

Gøhrn (V.), Henriksen (H. A.) & Petersen (B. B.). **Iagttagelser over *Hylesinus* (*Dendroctonus*) *micans*. Biologi. Undersøgelser af to angreb på sitkagran. Bekaempelsesforsøg.** [Observations on *Dendroctonus micans*. Biology. Investigations on two Outbreaks on Sitka Spruce. Tests on Control.]—*Forstl. Forsøgsv. Danm.* **21** pt. 4 pp. [4+] 383–433, 18 figs., 33 refs. Copenhagen, 1954. (With a Summary in English.)

Outbreaks of *Dendroctonus* (*Hylesinus*) *micans* (Kug.) began in plantations of Sitka spruce (*Picea sitchensis*) close to the sea at two places in North

Jutland, Denmark, one in 1948 and the other in 1951, and as little was known of the bionomics of this bark-beetle, investigations were carried out, with a view to developing control methods.

From examination of galleries and the stages found in them, it is concluded that the life-cycle of *D. micans* normally lasts two years. Oviposition begins about June and continues throughout the summer. The larvae overwinter in the second or third instar, and some of them complete their development in the following summer and give rise to adults that overwinter, whereas the others overwinter again in the fifth instar before giving rise to adults, and these adults may overwinter before reproducing. Pupation occurred in June–September, and emergence from the individual galleries continued over a considerable period. The natural enemies observed included two Nitidulid predators, *Rhizophagus grandis* Gylh., which was common, and *R. dispar* (Payk.), which occurred at one place, and an Ichneumonid parasite, *Ephialtes terebrans* (Ratz.).

Lead arsenate was tested for control. It proved toxic to adults confined with bark sprayed with it in the laboratory, but no protection was afforded in the field when trees were sprayed with a mixture of lead arsenate, lime and skim milk (as a spreader and adhesive), possibly owing to the difficulty of obtaining good coverage on the lower parts of the trunks and the use of an insufficiently effective adhesive.

PETERSEN (B. B.). **Bladhvepsen** *Lygaeonematus abietinus* **Christ som skadedyr på rødgran i Sønderjylland.** [*Pristiphora abietina* as a Pest of Norway Spruce in South Jutland.]—*Forstl. Forsøgsv. Danm.* **22** pt. 2 pp. [3 +] 275–355, 3 pls. (2 col.), 15 figs., 30 refs. Copenhagen, 1956. (With a Summary in English.)

Pristiphora (*Lygaeonematus*) *abietina* (Christ) caused considerable damage to Norway spruce (*Picea abies*) in South Jutland between 1940 and 1950, especially in a plantation near the southern border. The life-history of the sawfly is reviewed from observations in 1950–53 and the literature [*cf. R.A.E.*, A **25** 212], details are given of the injury caused, and notes are included on the forecasting of infestation and on other sawflies observed on the trees.

Experiments on control were begun in 1949, when a parathion spray applied from an aeroplane in a preliminary test gave promising results against the larvae. In 1950, sprays of 1·5 per cent. parathion and 5 per cent. quassia and a dust of 0·6 per cent. derris were applied between 8th and 12th June, when the majority of the larvae had reached the third or fourth instar, and the results were assessed by the use of funnels placed beneath sample trees to catch the frass and any larvae that left the trees. The mortality percentages given by the treatments were assessed at 91 for parathion, 67 for derris, which was known to be effective against the sawfly but was accidentally applied at too low a rate, and 14 for quassia. In 1951, an apparatus capable of applying dusts and sprays separately or simultaneously was tested, mounted on a jeep. Parathion applied as a spray, and derris applied as a dust alone or in combination with a spray of water, gave good results, but the distance covered by the spray was less than 100 ft. The range for dusting appeared to be about 100 yards, and the maximum tree height covered about 45 ft.

In subsidiary tests, various contact insecticides were applied to the eggs of *P. abietina* in sprays or dusts. All had some effect, and the best results were given by sprays of 1–1·5 per cent. parathion and 0·5 per cent. Systox [diethyl 2-(ethylthio)ethyl phosphorothioate (demeton)], which reduced

hatching by 70–71 and 67 per cent., respectively, in four days. When sprays were applied to larvae that were then transferred to untreated foliage, the minimum concentrations that gave complete kill in three days were 0·005 per cent. for parathion, 0·5 per cent. for γ BHC, chlordane and Systox and 1 per cent. for DDT. When untreated larvae were placed on treated foliage, parathion gave complete kill in two days at 1·5 per cent. two days after application and in three days at 1 per cent. three days after application, and the other materials proved less effective, though they killed high percentages of the larvae in some tests. All still showed some toxicity after a fortnight.

The natural enemies observed included *Polyblastus* sp., which parasitised last-instar larvae on the trees and larvae in their cocoons in the litter, and *Formica rufa* L., which preyed on larvae that dropped from the trees, but had a radius of activity of not more than about 100 ft. from the nest.

Rubtsov (I. A.). **Pests of *Citrus* and their natural Enemies.** [*In Russian.*] —*Nauchno-popul. Ser. vsesoyuz. ent. Obshch.* no. 2, 8¼ × 5¼ ins., 260 pp., 70 figs., 5½ pp. refs. Moscow, 1954. Price 4 *rub.* 95 *kop.*

This book was compiled in view of the recent extension of *Citrus* cultivation in the Soviet Union, especially in North Caucasus, the Crimea and Central Asia. The bulk of it is devoted to insect parasites and predators of *Citrus* pests, but since a knowledge of the biology of the latter is essential for an understanding of the ways in which the former may best be used, notes on the principal insects and mites that attack *Citrus* in the Union are given in introductory sections. The natural enemies dealt with are chiefly those already present, but some known only in other countries are included, since their introduction might prove desirable. The information given on them relates to morphology, bionomics, distribution, effectiveness, and, when known, methods of use for biological control. Notes on hyperparasites are included.

Berville (P.), Gauthier (J. L.) & Guy (R.). **Essais de traitement effectué sur les chenilles d'***Arctia caja* **(chenilles bourrues).**—*Phytoma* **8** no. 81 pp. 23–24. Paris, 1956.

Larvae of *Arctia caja* (L.) periodically cause severe damage to the buds of vines in southern France, and DDT, aldrin, dieldrin and γ BHC were tested against them in emulsion sprays in April 1956. When larvae were placed on various plants, sprayed in the laboratory and removed to untreated plants, the mortality percentages after 48 hours were 100 for dieldrin at 0·16 and 0·2 per cent., 90 for 0·2 per cent. aldrin, 50 for 0·01 per cent. γ BHC and 34 for 0·1 per cent. DDT. The corresponding percentages when unsprayed larvae were allowed to feed for ten minutes on sprayed plants were 86·5, 93·5, 90, 62·5 and 31·8, respectively. In a test on heavily infested vines, complete protection of the buds was given by a single application of dieldrin at 0·2 per cent., but 0·15 per cent. dieldrin or aldrin appeared insufficient.

Bouron (H.) & Mimaud (J.). **Essais de traitement sur les acariens des arbres fruitiers en 1955.**—*Phytoma* **8** no. 81 pp. 25–27. Paris, 1956.

Tests were carried out in 1955 against the summer eggs of *Metatetranychus ulmi* (Koch) on peach near Lyons and on pear near Paris, and against the active stages of *Bryobia praetiosa* Koch on peach near Marseilles. The

winter eggs of *B. praetiosa* hatched from the end of March, and sprays were applied once, on 20th April, before the mites had begun to oviposit. The numbers of eggs and mobile forms per 20 leaves on 27th April and (in brackets) before treatment were 0 (604) for 0·025 per cent. demeton [diethyl 2-(ethylthio)ethyl phosphorothioate], 11 (994) for 0·025 per cent. parathion, 22 (849) for 0·024 per cent. EPN [O-ethyl O-p-nitrophenyl phenylphosphonothioate], and 42 (719) for 0·05 per cent. malathion, as compared with 904 (651) for no treatment. There was no significant difference between sprays.

Near Lyons, the winter eggs of *M. ulmi* hatched from 12th April, and summer eggs were observed from 5th May. The sprays were applied on 12th May and 13th and 27th July, when maximum numbers of eggs were present. Before treatment, the number of eggs and mobile forms per 20 leaves was 7,074–9,670. On 13th and 21st July and 3rd August, the corresponding numbers, as compared with 5,991, 11,715, and 8,679, respectively, for no treatment, were 2,405, 1,323 and 86 for 0·025 per cent. Chlorobenzilate [ethyl 4,4′-dichlorobenzilate], 1,306, 2,471 and 147 for 0·05 per cent. p-chlorophenyl p-chlorophenylsulphonate, 377, 691 and 169 for 0·025 per cent. p-chlorophenyl phenylsulphonate and 2,705, 4,600 and 2,188 for 0·1 per cent. diphenylsulphone.

Near Paris, where the same sprays as used at Lyons were applied on 23rd May and 8th June, the winter eggs hatched from 28th April, the first adults were observed on 12th May and summer eggs were abundant from 18th May. Before treatment, the number of eggs and mobile forms on 20 leaves was 625–1,318. On 4th and 18th June, when they were 1,766 and 2,560, respectively, for no treatment, the corresponding numbers were 475 and 182 for Chlorobenzilate, 2,353 and 1,398 for p-chlorophenyl phenylsulphonate, 2,671 and 1,944 for diphenylsulphone, and 1,079 and 2,174 for p-chlorophenyl p-chlorophenylsulphonate.

The apparently poor results obtained against the summer eggs are attributed to the overlapping of the generations and the ineffectiveness of the compounds tested against the mobile stages. It is concluded that acaricides should be applied in early spring, before summer eggs are laid.

Bournier (A.) & Blache (M.). **Thysanoptères nuisibles aux pêchers.**— *Rev. Zool. agric.* **55** no. 1–3 pp. 1–8, 5 figs., 7 refs. Talence, 1956.

Peach trees in the Eyrieux valley, in the French Department of Ardèche, have been attacked in recent years by *Taeniothrips inconsequens* (Uzel) and *T. vulgatissimus* (Hal.) (*meridionalis* (Priesn.)). The adults and nymphs of the two species are briefly described. Observations on the bionomics of *T. inconsequens* showed that the adults emerged from the soil over a period of 3–5 weeks from late February or early March, the process beginning when the soil temperature at a depth of about 6 ins. reached 10–12°C. [50–53·6°F.]. Both sexes were present, and the males were functional. The females began to oviposit about 10 days after emergence and laid 120–160 eggs in the course of 3–4 weeks, inserting them into the bud scales, petals, sepals and young shoots. The nymphs hatched in 7–10 days and fed in the flowers and later on the leaves and terminal buds. The first instar lasted about a week, and the second-instar nymphs fed for about 2–3 weeks and then entered the soil, usually to depths of 10–12 ins., and constructed shelters in which they remained inactive from May to November. Ecdysis occurred with the onset of heavy rain, and the prepupal and pupal stages together lasted about a month. The adults remained within the shelters until the following spring. The bionomics of *T. vulgatissimus* are thought to be similar. The main injury caused was the deformation of the fruits.

Only *T. vulgatissimus* was found in the bottom of the valley, but both species occurred on the hillsides. In experiments on control, good results were obtained by spraying with 0·02 per cent. parathion at petal-fall.

Labeyrie (V.). **Observations sur la teigne du poireau** (*Acrolepia assectella* **Zeller**).—*Rev. Zool. agric.* **55** no. 1–3 pp. 8–13, 4 figs., 10 refs. Talence, 1956.

Acrolepia assectella (Zell.) is an important pest of leeks in France. The author reviews its life-history and shows that the only stages susceptible to control by insecticides are the adult, egg and first-instar larva. There were four generations in 1950 and 1951 near Bordeaux, the adults emerging in late May and June, in July and early August, from 10th August to 20th September, and in November; adults of the last generation overwinter. In the laboratory, at constant temperatures of 22·5, 25, 27 and 31°C. [72·5, 77, 80·6 and 87·8°F.], the females began to oviposit from the second day after emergence, and at 15°C. [59°F.], they did so after 4–6 days. Females kept for 48–51 hours at −10°C. [14°F.] and then at 30°C. [86°F.] oviposited in 2–3 days. Maximum numbers of eggs were laid at 22·5°C., the total being 252 per female. The oviposition period usually lasted 10–17 days. The eggs, which are laid on the external leaves, hatched in averages of 13, 4, 3 and 4 days at 15, 22·5, 27 and 31°C., respectively. Eggs were observed on 1st March at Bordeaux in 1952, and considerable damage had already been caused by larvae on 4th February at Menton. The larvae entered the leaves, sometimes directly from the egg, and mined in them for 2–5 days, after which they left their mines and moved to the heart leaves, where they were completely protected. At 15·5, 23, 24, 27 and 29°C. [59·9, 73·4, 75·2, 80·6 and 84·2°F.], the larval stage was completed in averages of 47, 18, 16, 14 and 10 days, respectively. The pupal stage averaged 14, 10 and 9 days at 15·5, 24 and 27°C.

Since the preoviposition period and egg stage are short, an insecticide effective against both the adults and young larvae offers the best chance of control. In tests, parathion at 0·01 and 0·15 per cent. in an emulsion and a suspension spray, respectively, proved effective against adults placed on leeks sprayed up to five days previously, and gave complete control when applied to the eggs, killing the larvae as they hatched or as they left their mines to enter the central leaves. Three applications, at intervals of eight days are recommended, beginning when the adults first appear.

Roehrich (R.). **Au sujet du passage de la tordeuse du pêcher** (*Laspeyresia molesta* **Busck**) **des pêchers aux pomacées.**—*Rev. Zool. agric.* **55** no. 1–3 pp. 14–16. Talence, 1956.

In France, *Cydia* (*Laspeyresia*) *molesta* (Busck) develops exclusively on the shoots and fruits of peach until about August, but later infests the fruits of pear, apple and quince, on which the intensity of attack increases as the season advances. The results are given of trapping experiments carried out in 1949–55 in south-western France; they showed that increased numbers of adults were taken per trap in a pear orchard from early September in 1949 and mid-August in 1952, the numbers taken, however, being always smaller than on peach. Similar increases on apple trees adjacent to a peach orchard were observed from August in 1951, July in 1952, 10th October in 1953 (when the shoots of peach remained green later than usual) and mid-July in 1954 and 1955, after which the numbers taken on apple were greater than those taken on peach.

Labeyrie (V.). **Sur quelques facteurs réglant la durée du cycle et l'intensité des attaques de la mouche de la carotte** (*Psila rosae* **Faber**) **dans le Bordelais.**—*Rev. Zool. agric.* **55** no. 1–3 pp. 22–24, 8 refs. Talence, 1956.

Psila rosae (F.), which infests carrots, has two generations a year near Bordeaux, the adults being present in March and September. The population is much greater in autumn than in spring, and the factors responsible for mortality of the overwintering larvae and pupae are discussed. The larval stage lasts 20–30 days in spring and about four months in October–February, and the pupal stage lasts about two months in both generations. When last-instar larvae were collected from the soil on 27th January 1950, after four days when the temperature of the soil at a depth of about 2 ins. had been −3°C. [26·6°F.], 60 per cent. of them died in six days at 19°C. [66·2°F.], and it is therefore concluded that many overwintering larvae are destroyed by cold. High soil humidity in autumn and winter favours the development of bacteria and nematodes; 70 per cent. of the larvae collected in November 1949 were destroyed by nematodes, and 15 per cent. of the others apparently by bacteria. Of the pupae, 44 per cent. were parasitised by *Dacnusa gracilis* (Nees), and adults of this Braconid, which attacks the larvae, emerged from 34 per cent. of the pupae collected in the following winter. Mermithids were found in 3 per cent. of the larvae collected in 1949. Some 90 per cent. of the overwintering population in 1949–50 was thus destroyed by natural means, but the reproductive capacity of the species is sufficient to restore the population by autumn, an average of 40 eggs being laid per female in the laboratory.

Lemoigne (M.) & others. **Essais d'utilisation de** *Bacillus thuringiensis* **Berliner contre** *Pieris brassicae* **L.**—*Entomophaga* **1** pp. 19–34, 5 graphs, 15 refs. Paris, 1956. (With a Summary in English.)

A strain of entomophagous bacteria isolated in 1952 from foliage from a silkworm farm at Anduze and referred to as the Anduze strain of *Bacillus thuringiensis* (though Toumanoff considers it a strain of *B. cereus* [*cf. R.A.E.*, A **44** 435]) was tested in the laboratory and in the field near Toulon against larvae of *Pieris brassicae* (L.). It was cultured on a liquid medium, and water suspensions of the spores were prepared. In preliminary tests, it proved more effective than several others against *P. brassicae* and more effective against *P. brassicae* than against other Lepidopterous larvae; it had little effect on beetle larvae. There was no loss of virulence in four months when concentrated suspensions were stored at low temperatures. The strain was maintained in the laboratory by transference to fresh culture media at frequent or infrequent intervals, by alternating between an artificial medium and larvae of *P. brassicae* or *Bombyx mori* (L.) or by alternating solely between these two insects. No diminution of virulence was observed in three years when it was maintained partly or wholly in the insects, and no more than slight diminution when it was transferred at infrequent intervals (every 2–3 months) to fresh artificial media, though frequent transference (every 48 hours) resulted in some loss. No adverse effects were observed in rabbits or sheep that fed on leaves of cabbage sprayed with spore suspensions.

A technique was developed for testing suspensions in the laboratory, foliage being sprayed with 10 cc. on a turntable under a bell-jar and allowed to dry before being fed to the larvae. The spore deposit was found to be proportional to the concentration of the suspension. When third-instar larvae of *P. brassicae* were confined on sprayed leaves, the mortality percentages after 4, 6, 8 and 10 days were 4, 32, 64 and 100, respectively, for a spore concentration of 84 million per cc., 10, 20, 64 and 80, respectively, for 42

million per cc., and 10, 28, 48 and 60 for 21 million per cc. At a concentration of 200 million spores per cc., complete kill of larvae in the second and third and in the third and fourth instars was obtained in 6 and 8 days, respectively, and there was no mortality in the controls. The spores were effective in the culture medium and in distilled water, and no mortality was caused by the medium when the spores had been filtered from it.

In a plot test in July 1954, fourth-instar larvae placed on cabbages that had been sprayed with a suspension containing 375 million spores per cc. died without feeding, and the bacterium was found in the dead larvae. The main field test was carried out in 1954 on cauliflower in a district in which *P. brassicae* is injurious at the end of the season. A suspension containing 200 million spores per cc., with the addition of a non-ionic wetting agent, was applied on 26th November at a rate equivalent to 126 gals. per acre. Heavy rain followed the treatment, but mortality began on the following day and the plants were almost completely free from infestation by 9th December. No reinfestation had occurred by the end of the month. The larvae developed normally on untreated plots, and the plants were so severely attacked that control measures were required.

Biliotti (E.). **Entomophages et maladies des insectes.**—*Entomophaga* **1** pp. 45–53, 21 refs. Paris, 1956. (With a Summary in English.)

An account is given of investigations carried out in France in 1953–54 on the effects of the Anduze strain of *Bacillus thuringiensis* [*cf.* preceding abstract] on insect parasites of *Pieris brassicae* (L.) within their hosts. Fourth-instar larvae of *Pieris* containing last-instar larvae of *Anilastus ebeninus* (Grav.) or younger larvae of *Apanteles glomeratus* (L.), and fifth-instar larvae of *Pieris* containing larvae of *Apanteles*, were placed in groups of 20–25 on cabbage leaves that had been sprayed with suspensions containing 350–1,400 million spores per cc. Development of the parasites was normal, the only difference observed being that larvae of *Apanteles* left their hosts to pupate somewhat earlier than those in the control groups. The rate of development of *Apanteles* larvae in larvae of *Pieris* was investigated in the laboratory at 15–17°C. [59–62·6°F.] and 60 per cent. relative humidity, and it was found that they did not reach the last (third) instar until the host had been in the fifth instar for at least nine days. When parasitised *Pieris* larvae that had reached the fifth instar were exposed after various intervals to material sprayed with a suspension containing 780 million spores per cc., the parasite larvae in hosts that had been in the fifth instar for at least nine days prior to treatment completed their development normally and emerged in a significantly shorter period than in the controls, but none emerged from hosts exposed to the treatment less than nine days after the moult. These results were confirmed in a further test at 18°C. [64·4°F.]. When the parasites had reached the last instar at the time of exposure of the host, there was no significant difference in the numbers emerging from treated and untreated host larvae.

In the treated plots [*cf.* preceding abstract], considerable mortality was observed among young larvae of the Syrphid, *Xanthandrus comtus* (Harris), which is predacious on larvae of *P. brassicae*.

Biliotti (E.), Grison (P.) & Martouret (D.). **L'utilisation d'une maladie à virus comme méthode de lutte biologique contre** *Pieris brassicae* **L.**—*Entomophaga* **1** pp. 35–44, 7 figs., 26 refs. Paris, 1956. (With a Summary in English.)

A virus disease of the granulosis type was observed attacking larvae of *Pieris brassicae* (L.) in the laboratory in France, and tests were carried out

near Toulon in 1954–55 on the possibility of using it for field control. Following favourable preliminary results, a spray prepared from crushed larvae and containing approximately 100,000–1,000,000 inclusion bodies per cc., with a non-ionic wetting agent, was applied on 1st December 1955 at about 14·5 pints per 100 sq. yards to cauliflowers severely infested by larvae of *P. brassicae*, then mostly in the fourth or early fifth instar. The larvae in an untreated plot developed normally. In the treated plots, development was retarded, larvae showing typical symptoms of granulosis were observed on 22nd December and no survivors were found after ten days. Some larvae were not accounted for at the final examination and it was assumed that they had fallen from the plants after death or had been destroyed by predators. Others pupated soon after the treatment had been applied, and when the pupae were removed to the laboratory, adults emerged and oviposited normally, but large numbers of the resulting larvae died in the first instar from the disease. It is concluded, therefore, that even if the virus is not disseminated until some of the larvae are about to pupate, the treatment should result in almost complete destruction of the population.

Semal (J.). **Note sur la présence en Belgique de** *Myzus ascalonicus* **Donc. (Homoptera—Aphididae).**—*Parasitica* **11** no. 4 pp. 134–138, 12 refs. Gembloux, 1955. (With a Summary in English.)

In May 1955, *Myzus ascalonicus* Doncaster was observed for the first time in Belgium on chicory (*Cichorium intybus*), *Stellaria media*, potato, and, to a less extent, *Dahlia*, in a greenhouse at Gembloux.

This Aphid is shown from a survey of the literature to have been recorded from seven other European countries [*cf. R.A.E.*, A **43** 144], including Austria, Sweden and Switzerland [*cf.* also **44** 228], and its bionomics and importance as a vector of plant viruses are reviewed [*cf.* **43** 144, etc.].

Semal (J.). **Quelques transmissions par pucerons de** *Cucumis virus* **I Doolittle à partir de dahlia.**—*Parasitica* **11** no. 4 pp. 118–123, 14 refs. Gembloux, 1955. (With a Summary in English.)

Studies were carried out in Belgium in 1955 on the possibility of using Aphids to determine the presence of the virus of cucumber mosaic (*Cucumis* virus I of Doolittle) in *Dahlia*, in which the symptoms are not typical and sometimes absent. The Aphids, which had fasted for 2–3 hours, were allowed to feed on infected *Dahlia* leaves for up to two minutes and were then kept for 24 hours, in groups of ten, on young cucumber plants showing only the cotyledons or the beginnings of the first leaf. Transmission was effected by *Aphis gossypii* Glov. and *Myzus ascalonicus* Doncaster, but not by *M. persicae* (Sulz.), *A. fabae* Scop. or *Macrosiphum* (*Aulacorthum*) *solani* (Kalt.). *Myzus ascalonicus* was a somewhat less efficient vector than *A. gossypii*, and the efficiency of the latter was considerably lessened when the numbers per cucumber plant were reduced from ten to five. *M. persicae* and *M. ascalonicus* transmitted the virus from *Dahlia* to tobacco seedlings.

Semal (J.). **Transmission of Beet Mosaic Virus from** *Stellaria media* **and** *Capsella bursa-pastoris* **by** *Myzus ascalonicus* **Doncaster.**—*Nature* **178** no. 4531 pp. 501–502, 1 ref. London, 1956.

Myzus ascalonicus Doncaster was found overwintering on *Stellaria media* in the field at Gembloux in 1955–56, close to a field from which fodder beet had been harvested in October 1955. To determine whether the Aphid was a vector of beet viruses, nymphs and adults of the spring generation were transferred in groups of 5–10 to beet seedlings and left for 48 hours. After

20–30 days, chlorosis was evident on three of the 18 seedlings and the plants were stunted. When five healthy plants were inoculated with sap from one of these, mosaic symptoms appeared on the young leaves of all of them within seven days, and the virus transmitted thus appeared to be *Beta* virus 2. Mosaic symptoms also appeared on young beet leaves when examples of *M. persicae* (Sulz.) that had fasted for two hours were allowed to feed for 1–2 minutes on the original infected seedlings and were then left for 24 hours, in groups of ten, on test plants. Using the same technique, the virus was transmitted by *M. persicae* back to *Stellaria* seedlings and from these, by *M. ascalonicus*, to beet seedlings. In preliminary tests, beet mosaic was transmitted from infected *Capsella bursa-pastoris* to beet by *M. ascalonicus*. This Aphid was previously considered not to be a vector of beet mosaic [*cf. R.A.E.*, A **35** 206], but tests showed that it transmits it from infected *S. media* in the field, and from artificially infected *Stellaria* and *C. bursa-pastoris*. The virus has not previously been recorded from these weeds. The virus of beet yellows was also found in *S. media* and it is thought probable that *M. ascalonicus*, which is known to be a vector of it [*cf. loc. cit.*], transmits it from this plant in the field.

Mellini (E.). **Studi sui ditteri larvevoridi I.** *Phytomyptera nitidiventris* **Rond.** [Studies on Tachinids. I. *P. nitidiventris.*]—*Boll. Ist. Ent. Bologna* **20** (1954) pp. 309–332, 9 figs., 20 refs. Bologna, 1955. **II.** *Meigenia mutabilis* **Fall. su** *Agelastica alni* **L. (Coleoptera Chrysomelidae).** [II. *M. mutabilis* on *A. alni.*]—*Riv. Parassit.* **15** no. 4 pp. 489–512, 9 figs., 24 refs. Rome, 1954. (With a Summary in English.)

In the first of these two parts, descriptions are given of the egg, larva and puparium of the Tachinid, *Phytomyptera nitidiventris* Rond., which parasitises the larvae of various Lepidoptera, together with an account of observations on its bionomics as a parasite of *Adaina* (*Pterophorus*) *microdactyla* (Hb.) on *Eupatorium cannabinum* near Bologna.

In the second part, the author describes the egg, larva and puparium of *Meigenia mutabilis* (Fall.), which also has numerous hosts [*cf. R.A.E.*, A **38** 223], and records observations on its bionomics on *Agelastica alni* (L.) during an outbreak of this Galerucid on alder [*Alnus*] near Pistoia in 1953. The females laid their eggs on the host larvae in June and the first ten days of July, and though several eggs were frequently observed on one host, only one parasite completed development in it. When larvae in all instars were present, the females oviposited preferentially on those in the second, though under the stimulus of the maturing eggs, they readily oviposited on larvae in other instars and, in the laboratory, on leaves. The larvae hatched in 1–2 days, entered the body-cavity of the host, moving freely until the latter became full-fed, and then becoming fixed, and completed their development rapidly, the period required being as little as a week in older hosts. Pupation usually occurred in the skin of the host, often in the soil, and the pupal stage lasted about ten days.

Frediani (D.). **Note morfo-biologiche sulla** *Cicadella viridis* **L. (Homoptera Jassidae) nell'Italia Centrale.** [Morphological and biological Notes on *Tettigella viridis* in central Italy.]—*Boll. Lab. Ent. agr. Portici* **14** (1955) pp. 1–47, 29 figs., 13 refs. Portici [1956]. (With a Summary in English.)

All stages of *Tettigella* (*Cicadella*) *viridis* (L.) are described, records of the plants on which it feeds and those on which it oviposits are reviewed from the literature, and an account is given of observations in a botanical

garden at Pisa in 1953–55. The Cicadellid had three generations a year, the first adults emerging on 24th May, 21st July and in late September, respectively, and it overwintered in the egg stage. Females of the overwintered and first generations oviposited in the stalks of various plants, particularly *Agropyrum repens* and *Erigeron canadensis*, but those of the second generation laid eggs exclusively in the stems of rose, even though other plants previously recorded as bearing overwintering eggs were available. Some of the eggs laid by these last adults hatched in October, but the nymphs died in November–December. The oviposition slits, which considerably damage the plants, are briefly described. Grafted rose plants that did not branch close to the soil were considerably less attacked than bush or climbing varieties, and the eggs were laid in groups of 3–18. Of 100 overwintered eggs collected on 1st–15th April, 34 were parasitised by a hitherto unknown species of *Anagrus*; 96 adult parasites emerged from the 34 eggs. Notes on the spring and summer development of *T. viridis* are given, and methods of control are briefly reviewed [*cf. R.A.E.*, A **35** 225]. Sprays of 0·15 and 0·25 per cent. parathion applied on 7th February to rose stems in which eggs had been laid proved useless.

Zinna (G.). **Un nuovo parassita della** *Dioryctria splendidella* **H.S.** *Crataepoides russoi* **n.sp., rappresentante di un nuovo genere.** [A new Parasite of *D. splendidella*. *C. russoi*, sp.n., a Representative of a new Genus.]—*Boll. Lab. Ent. agr. Portici* **14** (1955) pp. 65–82, 9 figs., 7 refs. Portici [1956]. (With a Summary in English.)

The ectoparasite found attacking *Dioryctria splendidella* (H.-S.) on pine in the Province of Benevento in 1950 [*cf. R.A.E.*, A **41** 302] was submitted for identification to Masi, who considered that it belonged to a new Eulophid genus close to *Crataepus*, for which he suggested the name *Crataepoides*. Descriptions are given of the genus and of all stages of the species, for which the name *C. russoi*, sp.n., is proposed. The description of the genus is by Masi, and that of the species is a combination of descriptions by Masi and by the author.

The parasite was easily reared in the laboratory. The female punctured the host larva with its ovipositor, causing paralysis within 4–7 minutes, and then fed on the exudate from further punctures. Such feeding appeared necessary for the maturation of eggs, since the first was never laid earlier than nine hours after paralysis of the host. The females laid an average of about 40 eggs each per larva, with a maximum of 70, and the number was not increased by the provision of honey and water or of sugar solution, depending apparently on the size of the host. Females provided with host larvae or honey and water or kept without food survived for 30, 18 and 15 days, respectively. The egg, larval and pupal stages normally averaged about 1, 10–12 and 8 days, respectively, but the larval stage was completed in 5–6 days in August, at 32°C. [89·6°F.]. Numerous generations developed in the laboratory between early spring and November; development ceased when the temperature fell below 14°C. [57·2°F.].

Binaghi (G.). **Sulla ricomparsa in Italia dello** *Spermophagus subfasciatus* **Boh. (Coleoptera, Bruchidae) e raffronti con un altro bruchide nostrano del fagiolo.** [On the Reappearance of *S. fasciatus* in Italy, and Comparisons with another Italian Bean Bruchid.]—*Boll. Lab. Ent. agr. Portici* **14** (1955) pp. 83–93, 4 figs., 5 refs. Portici [1956]. (With a Summary in English.)

Spermophagus subfasciatus Boh. was first observed in Italy in 1917 on beans imported from Brazil [*cf. R.A.E.*, A **6** 382], but it was not recorded

there after 1920. In 1952, it was observed at Genoa, attacking dried *Phaseolus* beans imported from Angola, and it appeared that for more than four years beans from that source had been similarly infested. In view of the possibility of the Bruchid's becoming established in Italy, the author describes the egg and the adults of both sexes, gives characters distinguishing the adults from those of *Bruchus obtectus* Say (*Acanthoscelides obsoletus*, auct.), and reviews its distribution, its bionomics and the leguminous seeds that it attacks. At 28°C. [82·4°F.], which is the optimum, the life-cycle lasts 25–37 days. A few examples of *S. subfasciatus* were found to be parasitised by *Anisopteromalus calandrae* (How.) (*Aplastomorpha vandinei* (Tucker)). The methods of control recommended are fumigation with methyl bromide or a 1:9 mixture of ethylene oxide and carbon dioxide, or treatment of the infested seeds with γ BHC dust.

It is also reported that *Bruchus* (*Callosobruchus*) *maculatus* F., which was introduced into Italy in 1946 with chickpeas [*Cicer arietinum*] from Brazil, maintained itself for over seven years in the laboratory on Italian chickpeas, and it might, therefore, become established in Italy.

Compere (H.) & Zinna (G.). **Tre nuovi generi e cinque nuove specie di Encyrtidae.** [Three new Genera and Five new Species of Encyrtids.] —*Boll. Lab. Ent. agr. Portici* **14** (1955) pp. 94–116, 10 figs., 4 refs. Portici [1956].

The new Encyrtids described are *Acroaspidia myrmicoides*, gen. et sp.n., *Telcterebratus perversus*, gen. et sp.n., *Arachnosinis zululandiae*, gen. et sp.n., *Bothriocraera bicolor*, sp.n., and *Pseudaphycus perdignus*, sp.n. Descriptions are given of the adult female of *Acroaspidia* and of the adults of both sexes of the others. *A. myrmicoides* and *B. bicolor*, which were found parasitising *Ferrisiana* (*Ferrisia*) *virgata* (Ckll.) on cacao in Trinidad, and *P. perdignus*, which was reared from a consignment of mealybugs from Eritrea consisting chiefly of *Saissetia oleae* (Bern.), were reared in the laboratory in California on *Planococcus citri* (Risso). Large numbers of all three were liberated in *Citrus* groves in California infested by *P. citri*, but none of them became acclimatised. *T. perversus* is a hyperparasite and its host is unknown; the description is based on material collected in China. *Arachnosinis zululandiae* is described from material reared by C. W. Rust from the eggs of spiders collected on *Sansevieria* sp. in Zululand in 1925–26.

Russo (G.) & Santoro (R.). **Esperimenti di lotta antidacica eseguiti in Ascea Marina (Salerno) nel 1954.** [Experiments on the Control of *Dacus oleae* in Ascea Marina (Salerno) in 1954.]—*Boll. Lab. Ent. agr. Portici* **14** (1955) pp. 117–223, 31 figs., 1 fldg. table. Portici [1956]. (With a Summary in English.) **Esperimenti di lotta antidacica eseguiti in Ascea Marina (Salerno)—1954.**—*Ann. Fac. Sci. agr. Portici* (3) **21** pp. 17–82, 31 figs. Portici, 1956.

A detailed account is given in the first paper of further experiments on the control of *Dacus oleae* (Gmel.) on olive near Salerno [*cf. R.A.E.*, A **43** 374, etc.], carried out in 1954. The first adults emerged from overwintering pupae between 15th March and 15th April, and flies were taken in bait-pans throughout the year in the plain and lower slopes of the hills, where the experiments were carried out. Infestation of the olives began in July and became heavy after the rains in September. During the summer, there was considerable parasitism of the eggs by *Prolasioptera berlesiana* (Paoli) and of the larvae by *Dinarmus dacicida* Masi, *Eurytoma rosae* Nees, *Pnigalio* (*Eulophus*) *longulus* (Zett.) and *Eupelmus urozonus* Dalm. The last of

these was also hyperparasitic. The insecticides tested were parathion (alone or with DDT), malathion, dieldrin and arsenical bait-sprays, and the final percentages of olives that were commercially sound (uninjured, punctured only, or containing eggs that had not developed) were in most cases determined on 15th–18th November. By that time, not more than 2·4 per cent. of the olives on untreated trees were in that category.

In the tests with parathion, the first applications were normally made towards the end of September. When emulsion sprays were applied, with the addition of a wetter and adhesive, the percentages of olives that were commercially sound were 74·5 for three applications at 0·02 per cent., 76·6, 65·8–85·6 and 89·3 for one, two and three applications, respectively, at 0·05 per cent., 68·2–88 and 76·6–92·6 for two and three applications, respectively, at 0·075 per cent., and 97·2 for three applications at 0·1 per cent. When 0·5 per cent. copper sulphate or 1 per cent. of a product containing 16 per cent. copper oxychloride was added to the 0·05 per cent. parathion spray, the corresponding percentages were 97·5 and 91, respectively, for three applications. Besides increasing the effectiveness of parathion, the addition of copper sulphate reduced the numbers of olives containing *Prolasioptera berlesiana* that fell, apparently owing to its effect on the fungus with which *P. berlesiana* is associated [*cf.* **43** 173–174]. When parathion was applied twice at 0·5 per cent. at the rate of about $1\frac{3}{4}$ pints per tree (about one-fifteenth of the quantity of liquid used for normal-volume spraying), by means of a knapsack atomiser or a low-volume jet attached to a sprayer mounted on wheels, the percentages of sound olives were 81·4 and 89·4, respectively. One application of an emulsion concentrate (Didifos) containing 45 per cent. DDT and 5 per cent. parathion, in a normal-volume spray at 0·5 per cent., with a wetter and adhesive, followed by one or two applications of 0·05 per cent. parathion, resulted in 71·9 and 86·6 per cent. sound olives, respectively. When the same insecticides were applied in low-volume sprays, Didifos being used at 5 per cent. and parathion applied twice at 0·5 per cent., the percentage was 82. Three applications of 0·5 and 1 per cent. of a light mineral-oil product containing 10 per cent. parathion resulted in percentages of 96 and 94, and two and three treatments with dusts containing 2 per cent. parathion, applied at a little over 1–2 lb. per tree, resulted in 71·2–75 and 65·6–81 per cent. sound olives, respectively.

Further trees were treated six times between late June and mid-September with the Berlese bait-spray of molasses and sodium arsenite [*cf.* **42** 112] followed by two or three applications of parathion at 0·05 per cent. in an emulsion spray or 2 per cent. in a dust, and the percentages of olives commercially sound were 75·6, 87·8, 62 and 71·2, respectively. When two applications of the bait-spray in September were followed by two or three of 0·075 per cent. parathion, the corresponding percentages were 65·2 and 85.

A 50 per cent. dieldrin wettable powder and a 20 per cent. dieldrin emulsion concentrate gave poor results when applied twice in low-volume sprays at 2 and 5 per cent., respectively, with or without the addition of a wetter and adhesive or of molasses, as also did three applications of malathion at 0·1 or 0·2 per cent. in emulsion sprays or 1 per cent. in a dust. A bait-spray containing sweet attractive substances and 6 per cent. sodium arsenite (Adacus 10) diluted to 5 per cent. in water was applied 11 times between late June and mid-November but failed to afford protection late in the season.

In view of the effectiveness of parathion against both the adults and the immature stages of *D. oleae* within the fruits [*cf.* **44** 201, etc.], treatment with it is recommended. One application may be adequate for early varieties in dry areas, though two will generally be necessary for late varieties in dry areas and all varieties in damp cool areas, and three may be

required for late varieties in cool areas. Low-volume spraying is recommended for areas in which water is scarce. The parathion residues in the oil from olives sprayed twice with 0·05 per cent. parathion did not exceed 3 parts per million and are therefore harmless [*cf.* **44** 138]. No toxic effects were observed among workers who applied parathion sprays during the preceding six years or among the local consumers of the oil.

The second paper is virtually identical with the first but lacks the 15 detailed tables of results and the English summary.

Russo (G.). **Stato attuale della lotta contro la mosca delle olive** (*Dacus oleae* **Gml.**). [The present Position in the Control of *D. oleae.*]—*Boll. Lab. Ent. agr. Portici* **14** (1955) pp. 225–257, 10 figs., 15 refs. Portici [1956]. (With a Summary in English.)

The author quotes (in French) the conclusions reached and the recommendations made at an international conference on the control of *Dacus oleae* (Gmel.) held in Athens in 1955, and reviews the results obtained with organic insecticides in large-scale experiments on the control of this fruit-fly on olive in Italy since 1950, with particular reference to the work carried out near Salerno [*cf.* preceding abstract, etc.]. Though parathion proved the most effective, against both adults and immature stages, the problem of toxic residues in the oil from treated olives has caused concern and is discussed at some length. In view of the promising results obtained in 1954 when copper sulphate was added to emulsion sprays containing parathion [*cf.* preceding abstract], further tests were made in 1955. Sprays of 0·03 and 0·05 per cent. parathion with 0·1 per cent. copper sulphate were applied once in September and once in the first ten days of October. Good control was given by both concentrations, and the residues of parathion in the oil did not exceed 1 part per million (the amount currently tolerated in the United States) and were less than those from olives treated with equivalent amounts of parathion alone. It thus appears that copper sulphate accelerates the breakdown of parathion in the olives.

A spray programme designed to reduce insecticidal residues to a minimum is suggested. In the second half of June and first ten days of July, trees with fruits likely to be selected for oviposition, especially early varieties with large fruits for table use, should be treated with emulsion sprays of DDT or lindane [γ BHC], alone or together, or dieldrin, to control the adults. Similar sprays of parathion with the addition of 0·1 per cent. copper sulphate should be applied in September–October, beginning when about 10 per cent. of the olives contain eggs or newly-hatched larvae. The concentration of parathion should be 0·05 per cent. in the first application and 0·03 per cent. in subsequent ones [*cf.* preceding abstract], or 8–10 times as great, with the addition of 0·5 per cent. copper sulphate, if low-volume sprays are used.

di Martino (E.). **Contributo alla conoscenza della** *Eumarchalia gennadii* **Marchal (Diptera Cecidomyiidae).** [A Contribution to Knowledge of *E. gennadii.*]—*Boll. Lab. Ent. agr. Portici* **14** (1955) pp. 258–287, 19 figs., 15 refs. Portici [1956]. (With a Summary in English.)

Injury to the pods of carob (*Ceratonia siliqua*), consisting of stunting and deformation, has become increasingly frequent in Sicily of recent years, particularly near Ragusa, and observations showed that *Eumarchalia gennadii* (Marchal) was responsible. The distribution, bionomics and control of this Cecidomyiid are briefly reviewed from the literature [*cf. R.A.E.*, A **3** 55; **25** 66; **26** 71], the damage caused is described, and detailed descriptions are given of the larva, pupa and adults of both sexes. Investigations

showed that the females, which outnumbered the males by six to one, laid only one egg per pod, and did not oviposit in those already infested. The immature stages overwintered in the pods, giving rise to adults towards the end of February. Young larvae of the first generation were present from late March to mid-April, and adults emerged in May. Larvae and pupae of the second generation were found in young pods in July, and the adults emerged in August and oviposited in the fruits of the main crop. From this time, the various stages were present together, and it was not possible to determine the number of generations a year. Eggs of the overwintering generation were laid by females that appeared in October–November. The parasites *Eurytoma dentata* Mayr, *Neanastatus proximus* Ferrière, *Tetrastichus brevicornis* (Panz.) (*flavovarius*, auct.) and *Pseudocatolaccus asphondyliae* Masi, emerged from material taken to the laboratory.

Balachowsky (A. S.) & Kaussari (M.). **Contribution à l'étude de la faune primitive des arbres fruitiers dans leur biotope ancestral. Sur un Coccoidea-Diaspidini nouveau nuisible à l'abricotier cultivé en Iran.** —*Boll. Lab. Ent. agr. Portici* **14** (1955) pp. 298–305, 2 figs., 20 refs. Portici [1956].

The authors briefly review investigations carried out since 1945 on the Coccid fauna of Persia, and describe the adult female of *Voraspis adlei*, sp. n., which was found infesting both surfaces of the leaves of apricot near Shiraz in September 1955.

Kuzmić (N.). **Opažanja iz biologije i suzbijanja maslinove mušice.** [Observations on the Bionomics and Control of *Dacus oleae*.]—*Plant Prot.* no. 25 pp. 45–52, 4 pls., 6 refs. Belgrade, 1954. (With a Summary in English.)

Experiments on the control of *Dacus oleae* (Gmel.) on olive in Yugoslavia in 1953 were carried out on the island of Lokrum, on which there are two groves. Adults were taken in bait-traps from late June and became very numerous after mid-August. Between 28th June and 7th October, a DDT spray was applied seven times in one grove and a DDT dust 13 times in the other, but the concentrations are not specified. The percentages of olives infested were 42 and 16 in mid-August and 14 and 67 in mid-September, respectively, as compared with 49–60 and 100 in untreated groves on the mainland.

Bogavac (M.). **Broj guseničnih stadijuma kod dudovca.** [The Number of larval Instars in *Hyphantria cunea*.]—*Plant Prot.* no. 25 pp. 76–83, 1 graph, 7 refs. Belgrade, 1954. (With a Summary in English.)

Observations in Yugoslavia in 1953 showed that *Hyphantria cunea* (Dru.) passes through 6–8 larval instars, mostly through seven. There was no difference between the sexes, but high temperature appeared to reduce the number.

Miles (M.). **Observations on the Emergence Periods, larval Populations and Parasitism of the Cabbage Root Fly** (*Erioischia brassicae* **Bché**).— *Ann. appl. Biol.* **44** no. 3 pp. 492–498, 1 graph, 9 refs. London, 1956.

The following is almost entirely the author's summary of this account of further investigations in south-eastern England [*cf. R.A.E.*, A **42** 409; **43**

165] in 1954–55. Adults of the overwintered generation of *Hylemyia* (*Erioischia*) *brassicae* (Bch.) emerged at outdoor temperatures in an insectary in a sharply defined period lasting from 4th April to 3rd May in 1954, and 75 per cent. of them emerged during 11th–19th April. The emergence period for the first-generation adults was from 28th June to 24th September. There was no well-defined peak period; adults emerged almost every day from 28th June to 16th August, with the highest numbers (11 per day) on 16th–17th July and the greatest concentration of emergences (41 per cent.) during 11th–21st July. In 1955, first-generation adults emerged from 24th June to 23rd August, with a peak emergence period during 6th–16th July, when 50 per cent. of the adults emerged. The differences between the dates of the peak periods of emergence in the two years were associated with differences in temperature in June and July; cooler weather appeared to delay emergence.

Counts of first-generation larvae and puparia in the latter half of June 1955 in an observation plot planted to cauliflower showed average populations of 59 per plant, with a maximum of 132. Counts after the plants had been exposed to attack during July and from mid-August to November showed an average infestation of less than two per plant. Plants exposed to attack from mid-May onwards until December showed average populations of 15 puparia per plant, of which only two puparia were viable. This gave further evidence that high infestation by *H. brassicae* occurs only in spring.

Larvae and puparia collected in June were allowed to complete their development in the insectary. In 1954, the adults that emerged from 350 puparia comprised 188 of *H. brassicae* (54 per cent.), 145 of the Cynipid parasite, *Trybliographa rapae* (Westw.) (41 per cent.), and 17 of the Staphylinid, *Aleochara bilineata* Gylh. (5 per cent.). In 1955, the numbers of each species that emerged from 990 puparia were 693 (70 per cent.), 296 (30 per cent.) and 1, respectively. The samples consisted of larvae and puparia in a ratio of about 3:1 and were biased in favour of *T. rapae*, since *A. bilineata* attacks the pupae [*cf.* **43** 435]. Observations on dates of emergence showed that in samples consisting wholly of viable puparia collected after mid-July, there is likely to be a bias in favour of the parasites because peak emergence of first-generation adults of *H. brassicae* has already passed.

Thorne (G. N.). **The Effect of Organophosphorus Insecticidal Sprays on the Growth and Phosphorus Content of Brussels Sprouts.**—*Ann. appl. Biol.* **44** no. 3 pp. 499–505, 8 refs. London, 1956.

The following is largely based on the author's summary of this account of experiments carried out in southern England in 1953 and 1955 to determine whether organic phosphorus insecticides exert any beneficial effects on the growth of plants in the absence of insect infestation [*cf. R.A.E.*, A **38** 30]. No evidence was found that the systemic insecticides, schradan and demeton [diethyl 2-(ethylthio)ethyl phosphorothioate], directly increase the growth of plants. The dry weight of brussels sprouts grown in pots in soil to which no nutrient phosphorus had been added was unaffected when the leaves were sprayed six times at weekly intervals with schradan or demeton at the recommended concentrations (0·3 and 0·1 per cent., respectively), or with a solution of sodium phosphate supplying the same amount of phosphorus as the insecticides. The dry weight of plants that were grown in soil to which a nutrient phosphorus compound had been added and that were, in consequence, larger, was not significantly increased by spraying with demeton or sodium phosphate; a schradan spray decreased it in 1955, but not in 1953. Spraying with schradan or the equivalent amount of phosphorus as sodium phosphate significantly increased the phosphorus content of plants

in soil without added phosphorus in 1955, and sodium phosphate, but not schradan, caused a slight but not significant increase in that of plants in soil with increased phosphorus content. The phosphorus content of plants on either type of soil was not significantly increased by schradan sprays in 1953 or by demeton sprays in either year.

Stringer (A.). **The insecticidal Activity of some Organophosphorus Compounds against the Migratory Locust** (*Locusta migratoria migratorioides* **Reiche & Fairm.**).—*Ann. appl. Biol.* **44** no. 3 pp. 506–510, 8 refs. London, 1956.

An account is given of laboratory investigations of the toxicity of 12 related organic phosphorus compounds to adult males of *Locusta migratoria migratorioides* (R. & F.). The materials were applied topically as acetone solutions or by injection into the body cavity as aqueous suspensions containing 1 per cent. (v/v) acetone, at rates of 10 and 5 μl. per locust, respectively, and mortality was assessed five days later. Paraoxon (diethyl p-nitrophenyl phosphate) was significantly more toxic than the other compounds, its LD50 being about 0·4 μg. per locust for topical application and 0·3 μg. for injection. The two methods of application also gave similar results for the other compounds, and LD50's were therefore computed for topical application only. They were 1–1·5 μg. per locust for parathion (O,O-diethyl O-p-nitrophenyl phosphorothioate), and alteration of the alkyl groups in this compound resulted in values of 0·63 μg. for methyl-parathion (O,O-dimethyl O-p-nitrophenyl phosphorothioate) and 34·34 μg. for O,O-di-2-chloroethyl O-p-nitrophenyl phosphorothioate; O,O-diisopropyl O-p-nitrophenyl phosphorothioate was very slightly toxic. Toxicity was about equal to that of parathion for O,S-diethyl O-p-nitrophenyl phosphorothioate and O,O-diethyl S-p-nitrophenyl phosphorothioate, but the substitution of a second p-nitrophenyl group in parathion or its O,S-diethyl isomer to give O-ethyl O,O-di-p-nitrophenyl phosphorothioate and S-ethyl O,O-di-p-nitrophenyl phosphorothioate, respectively, resulted in complete loss of toxicity. Tri-p-nitrophenyl phosphate was also non-toxic. The LD50's of EPN (O-ethyl O-p-nitrophenyl phenylphosphonothioate) and malathion (O,O-dimethyl S-1,2-di(ethoxycarbonyl)ethyl phosphorodithioate) were 2·24 and 28·7 μg. per locust, respectively, but the low mammalian toxicity of malathion renders it of practical use. The results are compared with those previously obtained with the grain weevil, *Calandra* [*granaria* (L.)] [*R.A.E.*, A **39** 200].

Watson (M. A.). **The Effect of different Host Plants of Potato Virus C in determining its Transmission by Aphids.**—*Ann. appl. Biol.* **44** no. 4 pp. 599–607, 11 refs. London, 1956.

The following is virtually the author's summary. A stock of potato virus C derived from Edgecote Purple potatoes in 1945 was not then transmitted by *Myzus persicae* (Sulz.), although more than 2,000 Aphids were used in conditions optimal for transmitting the serologically related potato virus Y. This stock of virus C was propagated continuously in the glasshouses at Rothamsted by manual inoculation of *Nicotiana glutinosa* and tobacco, and it was transmitted in 1955 by *M. persicae*; about one Aphid in 20 transmitted it, as compared with one in two for potato virus Y.

Virus C derived from Edgecote Purple potatoes in 1955 was not transmitted by *M. persicae*; both stocks of virus C produced only local lesions in Majestic potato leaves, and gave similar symptoms in tobacco. When

inoculated into Majestic potatoes and then returned to tobacco plants, potato virus C usually ceased to be transmissible by *M. persicae*, and it did not recover this property in any of the subsequent sub-cultures. Transmission from stock by *M. persicae* did not isolate a strain of virus C that was any more readily transmitted by Aphids; indeed, for the first 2–3 sub-cultures, Aphids usually transmitted more readily from plants infected manually. Nevertheless, the few isolates that remained Aphid transmissible, after a second passage through potato, were rather readily transmitted.

These results suggest that the ability of a virus to be transmitted by Aphids is, at least in part, determined by the host plant in which it is multiplying, but the nature of the changes that determine this ability is unknown.

Stringer (A.) & Fielding (A. H.). **The Anti-esterase Activity of Parathion and some related Organophosphorus Compounds.**—*Ann. appl. Biol.* **44** no. 4 pp. 626–633, 2 graphs, 9 refs. London, 1956.

Organophosphorus insecticides have been shown to be active inhibitors of cholinesterases, and there is a correlation between their ability to inhibit cholinesterase *in vivo* and their insecticidal activity. The toxic action may involve the inhibition of other esterase systems, however [*cf. R.A.E.*, A **39** 427], and the *in vitro* activity of preparations of *Locusta migratoria migratorioides* (R. & F.) and *Calandra granaria* (L.) indicated that two enzymes were present in both. These were acetylcholinesterase and an enzyme (acetylesterase) capable of hydrolysing o-nitrophenyl acetate and not acetylcholine [*cf. loc. cit.*], and their activities were at comparable levels in both insects. Their inhibition by organophosphorus compounds was also similar. The *in vitro* activity of the compounds with a phosphoryl group (paraoxon, O,O-diethyl S-p-nitrophenyl phosphorothioate and O,S-diethyl O-p-nitrophenyl phosphorothioate) was high, whereas that of the remaining compounds, which possessed a thiophosphoryl group, was low. The high insecticidal activity of parathion, which belongs to the second class, would be explained by *in vivo* conversion of a thiophosphoryl to a phosphoryl group [*cf.* **43** 37].

MacCuaig (R. D.). **Determination of the Resistance of Locusts to DNC in Relation to their Weight, Age and Sex.**—*Ann. appl. Biol.* **44** no. 4 pp. 634–642, 2 graphs, 14 refs. London, 1956.

The following is virtually the author's summary. Experiments showed that the resistance of adults of *Schistocerca gregaria* (Forsk.) and *Locusta migratoria migratorioides* (R. & F.) to DNC applied as a contact poison to the ventral surface of the abdomen is directly related to their body weight, irrespective of age or sex. Varying the site of application of the insecticide had little effect on the susceptibility of the insects except when the dose was applied to the wings or femur, these being less effective sites of entry for the poison. Increasing the post-treatment temperature from 25 to 36°C. [77 to 96·8°F.] had no noticeable effect on mortality, but the speed of action of the insecticide was much increased.

Steinhaus (E. A.) & Smith (R. F.). Ed. **Annual Review of Entomology. Volume 2.**—9 × 6 ins., viii + 407 pp., illus., many refs. Palo Alto, Cal., Annual Reviews, Inc., 1957.

The reviews in this second volume of a series [*cf. R.A.E.*, A **45** 70] comprise: **Digestion in Insects,** by D. F. Waterhouse (pp. 1–18, 139 refs.),

which includes a survey of research on factors concerned in the digestion of wool by *Tineola bisselliella* (Humm.) [*cf.* **44** 268, etc.]; **Some Aspects of intermediary Metabolism of Carbohydrates in Insects,** by M. Rockstein (pp. 19–36, 163 refs.), which includes a note on phosphorus metabolism; **The Physiology of Insect Cuticle,** by V. B. Wigglesworth (pp. 37–54, 75 refs.); **The Comparative Morphology of the Insect Head,** by E. M. DuPorte (pp. 55–70, 7 figs., 31 refs.); **Cytogenetics and Systematic Entomology,** by M. J. D. White (pp. 71–90, 86 refs.); **The Taxonomic Significance of the Characters of Immature Insects,** by F. I. van Emden (pp. 91–106, 1 fig., 147 refs.); **Caste Determination in Social Insects,** by M. V. Brian (pp. 107–120, 105 refs.); **Dynamics of Insect Populations,** by M. E. Solomon (pp. 121–142, 113 refs.); **The Synoptic Approach to Studies of Insects and Climate,** by W. G. Wellington (pp. 143–162, 80 refs.), in which reference is made to observations on the effects of meteorological factors on *Choristoneura fumiferana* (Clem.) in Canada [*cf.* **44** 113, etc.]; **Insect Migration,** by C. B. Williams (pp. 163–180, 62 refs.), which includes notes on locusts as well as other migratory insects; **Recent Advances in Veterinary Entomology,** by A. W. Lindquist & E. F. Knipling (pp. 181–202, 145 refs.); **Transmission of Disease Agents by Phlebotomine Sand Flies,** by S. Adler & O. Theodor (pp. 203–226, 1 fig., 104 refs.); **Genetics of Insect Resistance to Chemicals,** by J. F. Crow (pp. 227–246, 1 fig., 120 refs.); **The Mode of Action of Insecticides exclusive of organic Phosphorus Compounds,** by P. A. Dahm (pp. 247–260, 68 refs.), which deals chiefly with matter published since the earlier review by Kearns [**45** 70]; **Chemistry and Mode of Action of Organophosphorus Insecticides,** by E. Y. Spencer & R. D. O'Brien (pp. 261–278, 103 refs.); **The Behaviour of Systemic Insecticides applied to Plants,** by S. H. Bennett (pp. 279–296, 75 refs.); **Aerial Application of Insecticides,** by F. E. Weick & G. A. Roth (pp. 297–318, 65 refs.), who discuss the types of aeroplanes suitable for applying sprays and dusts against field-crop pests, the equipment necessary, and the effects of various factors on insecticide distribution; **Cotton Insects and their Control in the United States,** by J. C. Gaines (pp. 319–338, 134 refs.), which includes a table showing the rates at which various insecticides or acaricides are currently recommended in the United States for application against individual pests of cotton; **Insecticidal Control of the Spread of Plant Viruses,** by L. Broadbent (pp. 339–354, 73 refs.), in which attempts to reduce the spread of insect-borne virus diseases of crops by the application of insecticides against the vectors are reviewed, and it is shown that no known insecticide with persistent properties can kill quickly enough to prevent an infective insect from infecting a treated plant [*cf.* **44** 284]; and **Pollination of Alfalfa and Red Clover,** by G. E. Bohart (pp. 355–380, 140 refs.), which is concerned mainly with the manner in which lucerne and red clover are pollinated, ways of increasing the numbers of honey bees and wild bees in seed fields, and attempts to increase the efficiency of honey bees as pollinators.

Rivnay (E.). **The Mediterranean Fruit Fly, *Ceratitis capitata* Wied. Studies on its Toxicants, Mass Migration and Control in Israel.**— *Ktavim* (Engl. edn.) **4** no. 4 pp. 3–38, 14 figs., 27 refs. Rehovot, 1954.

Ceratitis capitata (Wied.) is an important pest of many fruits in Israel [*cf. R.A.E.*, A **38** 474]. It was known to migrate from one to another, and bait-traps were extensively used to study these movements. The results showed that there is not only considerable movement within a plantation, the flies congregating on trees that afford the particular ecological conditions required, though not always ovipositing in the fruits on them, but also

migration from one plantation to another, including, apparently, long-distance movements from the coastal plain to the hills.

Earlier methods of control, which are reviewed, did not prove satisfactory, and experiments with synthetic contact insecticides were begun in 1946. In laboratory tests of deposits on leaves, the insecticides proved most effective in wettable-powder sprays, since dusts lost their toxicity rapidly and emulsion sprays, though more persistent than dusts, were less stable than wettable powders and gave less uniform results, apparently owing to masking of the deposited insecticides by the emulsifiers. Of the insecticides tested as wettable powders, BHC gave the best initial control but was less persistent than methoxy-DDT (methoxychlor) or dieldrin [*cf.* **43** 204]; toxicity was more enduring in winter than in summer, BHC remaining effective for 14 days and methoxy-DDT for 25 days in summer, as compared with 21 and 40 days, respectively, in winter. The addition of attractants and of certain fungicides reduced efficiency, but a combination of insecticide and fungicide may be justified if the initial kill is satisfactory. The addition of oil, applied against Coccids, would produce a residue of reduced toxicity and stability, similar to that from an emulsion.

Field experiments were begun at the same time. Repeated dusting with DDT was unsatisfactory on peach in 1946, but some protection was afforded by sprays of chlordane, DDT, methoxy-DDT or BHC applied to deciduous fruits in 1949, 1951 and 1953 [*cf.* **43** 204] and to *Citrus* in 1950–52. The results are given in detail and discussed. They indicated little difference between insecticides. Spraying with a high concentration at long intervals was less effective than spraying with a low concentration at short ones, and there was some evidence that flies entering an orchard oviposited between contact with insecticide deposit and knockdown or death. The number of applications necessary depends on the speed of ripening of the fruit, apricots probably needing two applications and peach and pear three or four, as well as on the density of the fly population. A single spray in early or mid-October suffices to protect Jaffa oranges, as the fly causes negligible damage in September and is beginning to decline in activity in October. A similar autumn application may protect Valencia oranges if they are attacked in March, but spring treatment is required if they are attacked in April, as is usual. Spraying single trees or small groups did not protect them, as there is continual invasion from surrounding untreated trees, but spraying some of the trees in a *Citrus* grove gradually reduces the population throughout the grove, provided that climatic conditions are conducive to adult activity and no new generation develops.

Avidov (Z.). **Further Investigations on the Ecology of the Olive Fly (*Dacus oleae*, Gmel.) in Israel.**—*Ktavim* (Engl. edn.) **4** no. 4 pp. 39–50, 5 refs. Rehovot, 1954.

Emergence of *Dacus oleae* (Gmel.) in the laboratory from olives collected in groves in the coastal plain of Israel weekly from June to December in 1950–53 showed that there were usually four generations a year, development lasting 30–40 days, according to season. Oviposition began in early June, and the adults emerged in the first half of July, the second half of August, the second half of September and between the beginning of November and the beginning of February. Mortality of the immature stages was apparently high. Males and females emerged in equal numbers and lived for similar periods, the maxima being 22, 73, 79 and 168 days for the four generations, respectively. It is concluded that *Dacus* overwinters mainly in the adult stage [*cf. R.A.E.*, A **39** 62]. In tests at the end of

February, the adults remained motionless at temperatures below 17°C. [62·6°F.], were normally active at 23–29°C. [73·4–84·2°F.], became agitated above 29°C. and were inactive at 35°C. [95°F.] and above. The number of daylight hours with temperatures suitable for oviposition (20–30°C. [68–86°F.]) can be used as an indicator of the epidemiological potential, and analysis of climatic conditions in the interior valleys showed that the danger of infestation of European varieties of olive ceases with the beginning of the hot season, the number of hours of suitable temperature being small during most of the summer and the fruit being picked fairly early for green pickling, whereas the danger of infestation persists during the whole summer in the coastal plain and the hills and threatens all varieties. Conditions are particularly favourable for infestation if the olives are left on the trees to ripen fully.

There was no significant difference in attractiveness between solutions of ammonium sulphate and diammonium phosphate in glass traps in 1947–53, but very few flies were caught when the phosphate was used in wide aluminium dishes. The catches over six years showed two unequal peaks in the population curve, the higher one occurring in June and the lower in October, and were closely correlated with conditions suitable for *Dacus* activity. Only 40 per cent. of the adults taken were females; half those trapped in July, but much smaller proportions during the rest of the season, were gravid. Catches in trees of different varieties differed according to the degree of fruit development at the beginning of the season, but there were no significant differences between varieties over the year as a whole. The results obtained with five traps placed in a large tree in 1950–52 showed that the adults occurred mainly on the eastern side in May, September and October, on the northern in June and August, on the southern and western in November and April, respectively, and in the interior of the crown in July, indicating the tendency of *D. oleae* to avoid unfavourable temperatures.

Swirski (E.). **The Bionomics of the Pear Psylla** *Psylla pyricola*, **Foerst. in Israel.**—*Ktavim* (Engl. edn.) **4** no. 4 pp. 61–68, 5 graphs, 12 refs. Rehovot, 1954.

Psylla pyricola Först. is the only Psyllid on pear in Israel, where it causes serious damage in some years. Observations on its bionomics in the coastal plain showed that there are 10–11 generations a year. The winter was passed mainly in the adult stage, though a few nymphs survived. The winter adults first appeared in November and paired in January, and oviposition began in February in normal winters and rather earlier in warm ones, the summer adults appearing in late March or early April. Summer adults fed on leaf tissue and winter ones on young bark, and males and females survived for averages of 15·6 and 20·8 days, respectively, in summer and 34·9 and 54·8 days in winter; summer and winter females comprised 47·7 and 56·7 per cent. of the population and deposited averages of 174 and 53 eggs each, respectively. The eggs were laid on leaves if these were present, and in the axils of the buds or in bark crevices near them if they were not. The eggs hatched in averages of 4·7–6·3 days in May–August, 7–8 in October and November and 11·5 and 12 at the beginning of December and the beginning of March, respectively; unfertilised eggs did not hatch. The nymphs sucked the sap from the green parts of the opening buds in early spring, the leaves in spring, summer and autumn and the branches in late autumn; the nymphal stage lasted 24–29 days in early spring, 14–26 days in June–September and 32–50 days for examples that hatched in

November. No parasites were observed, but *Coccinella septempunctata* L., *C. conglobata* L. and *Scymnus* spp. were observed preying on the nymphs.

Chandy (K. C.). **A Note on** *Apanteles flavipes* **Cam., a Braconid Parasite of the Cholam Stem Borer,** *Chilo zonellus* **Swinh.**—*J. Bombay nat. Hist. Soc.* **53** no. 1 pp. 6–9, 1 fig., 7 refs. Bombay, 1955.

Chilo zonellus (Swinh.) is an important pest of sorghum in southern India, killing young plants and retarding the growth of older ones. Investigations carried out over two years near Coimbatore, where an average of 45–60 per cent. of the plants were attacked, showed that the most important natural enemy of the borer was *Apanteles flavipes* (Cam.), which parasitised 5–35 per cent. of the larvae. Parasitism was highest in late June and early July in the 1948 crop and in early March in the 1949 crop. Females of this Braconid oviposited in the host larvae within the stalks, several attacking one host in the laboratory. The affected larvae at first fed more voraciously than normal ones, but died before pupating, about five days after the emergence of the full-fed parasite larvae, which pupated close together within the stalks. The pupal stage lasted 3–5 days; 18–43 adult parasites matured per host, 73–97 per cent. of them being females. Liberation of the parasite early in the season might improve control, but *Corcyra cephalonica* (Stnt.) and *Spodoptera mauritia* (Boisd.) proved unsatisfactory hosts for rearing it in the laboratory.

Patel (R. C.) & Kulkarny (H. L.). **Bionomics of** *Urentius echinus* **Dist. (Hemiptera—Heteroptera: Tingidae) an important Pest of Brinjal (***Solanum melongena* **L.) in north Gujarat.**—*J. Bombay nat. Hist. Soc.* **53** no. 1 pp. 86–96, 2 pls., 14 refs. Bombay, 1955.

Urentius echinus Dist. is the most important insect pest of brinjal (*Solanum melongena*) in northern Gujarat, where this crop is extensively cultivated. The literature on the Tingid is briefly reviewed, and all stages are described. Infestation occurs chiefly from March to May and reaches a peak in April–May, when the summer crop is 3–4 weeks old. Adults and nymphs suck the leaf sap, the former feeding on the upper and the latter on the lower surfaces, and the leaves dry up as a result. In rearing experiments in the laboratory at 80–104°F., the eggs, which are inserted into the leaf tissue, hatched in 5–7 days, and the five nymphal instars were completed in about eight days. The preoviposition period lasted 2–3 days, and the females laid 4–165 eggs each, with an average of 74, in 1–13 days, dying soon after. At 60–89°F., males and females survived for 16–18 and 29–33 days, respectively. Good control of the adults was given in field tests by sprays containing 0·1 per cent. wettable DDT with about 0·1 per cent. nicotine sulphate, and by 0·2 and 0·3 per cent. wettable DDT alone. The 0·2 per cent. DDT spray is recommended as the least costly.

Khan (M. Q.) & Murthy (D. V.). **Some Notes on the Rice Gall-fly,** *Pachidiplosis oryzae* **(W.-M.).**—*J. Bombay nat. Hist. Soc.* **53** no. 1 pp. 97–102, 4 refs. Bombay, 1955.

Rice is widely cultivated in the Nizamabad district of Hyderabad State, but the transplanted monsoon crop, which is sown in June–July and harvested in November–December, has since 1947 been severely infested by *Pachydiplosis oryzae* (Wood-Mason), which was previously of minor importance. The second crop, which is sown in January–February and harvested

in April–May, is only lightly infested. Observations showed that the Cecidomyiid usually appears on the monsoon crop in the first or second week of July. Peak numbers of galls were observed from mid-August, and there was a second peak of infestation some 14–20 days later. Considerable parasitism of the larvae by *Platygaster oryzae* Cam. was observed at that time. Infestation declined from October. The number of generations was not determined, as there was considerable overlapping; adults survived for 3–5 days.

The date of transplanting had considerable influence on the degree of infestation, and the numbers of galls observed on eight plots, each 3 ft. square, in which rice was transplanted on 28th June, 5th, 12th, 19th and 26th July and 2nd August were 15, 28, 28, 21, 83 and 79, respectively. In another area, the average numbers of galls per two plots, each 3 ft. square, transplanted on 11th and 24th July were 1 and 9·5, respectively. It appears therefore, that sowing or transplanting after the last week in July is inadvisable. The incidence of attack was consistently low on one of several varieties investigated and unusually high on another.

Platygaster oryzae was the only natural enemy observed in the area, and it appeared rather late in the season. In 1952, the percentage parasitism rose from 0 on 19th August to 100 on 3rd September in one locality and from 0 on 28th July to 76·8 on 27th August in a second. Good protection was afforded by the use of light-traps over a period of ten weeks, beginning in the third or fourth week of July, and at harvest in 1952–53 there was a considerable increase in the numbers of mature ears produced in areas protected in this way, as compared with those left unprotected.

PUTTARUDRIAH (M.). **An epidemic Outbreak of Cardamom Hairy Caterpillar.** —*Indian Coff.* **19** no. 7 pp. 151–156, 4 figs. Bangalore, 1955.

An outbreak of *Eupterote canaraica* Moore on cardamom [*Elettaria cardamomum*] began in Mysore in 1953, and severe damage was caused in some plantations in 1953–54. The adult moths emerged after the monsoon rains in June–July, and the females oviposited in August–September on the leaves of shade trees. After feeding on these for a while, the larvae, which are gregarious, dropped by threads on to the cardamom plants. Feeding continued on the leaves of these until late December or January, when pupation occurred in débris beneath the shade trees [*cf. R.A.E.*, A **30** 559]. Pupae were also found among folded leaves of cardamom and *Citrus*. The pupal stage lasted 7–8 months. On the larger estates, considerable numbers of larvae were collected in October–December on and near the shade trees and destroyed. A spray of 1 lb. 50 per cent. wettable DDT in 16 gals. water was widely used and gave good control of the larvae, as also did 1 lb. honge [*Pongamia glabra*] oil resin soap per 10 gals. water. In tests, the mortality percentages in 24 hours were 87, 94 and 100 for 1 lb. honge-oil resin soap per 6, 8 and 10 gals. water, respectively, 98, 97, and 99 for 1 lb. fish-oil resin soap per 6, 8 and 10 gals. water, respectively, and 83–95 for various dilutions of a proprietary parathion product, as compared with 4 for water alone and 0 for no treatment. A 1·5 per cent. parathion dust gave 99 per cent. kill.

NIRULA (K. K.). **Investigations on the Pests of Coconut Palm. Part II.** *Oryctes rhinoceros* **L.**—*Indian Cocon. J.* **8** no. 4 pp. 161–180; **9** no. 1 pp. 30–79, 9 figs., 70 refs. Ernakulam, 1955.

In this second part of a series [*cf. R.A.E.*, A **44** 337], a detailed account is given of investigations on the bionomics and control of *Oryctes rhinoceros* (L.) on coconut in India, much of which has already been noticed or confirms

findings previously published [**43** 229–230]. In work on the control of the adults at Kayangulam, the value of spraying all potential breeding material in and round a coconut grove with BHC, combined with the use of breeding traps consisting of decaying organic matter and manure also sprayed with BHC, was investigated between June 1951 and June 1953. The test was carried out over some 6¼ acres of coconut palms and a strip 200 yards wide all round. Breeding materials throughout the area were sprayed monthly with 0·01 per cent. BHC, and 15 traps, each 4 × 2½ × 1 ft. in size and shaded with coconut leaves, were distributed among the palms; 12 of the traps were sprayed with enough wettable BHC to give a concentration of 0·1 per cent. in the breeding material. Each month, the palms were inspected for fresh attacks and all stages of *O. rhinoceros* present in the traps were removed. In August 1951, the numbers of eggs, larvae and adults collected in the 12 treated and (in brackets) the three untreated traps were 413 (111), 666 (145) and 10 (4), respectively, and all but seven of the larvae from the treated traps were dead or paralysed. By July 1952, totals of 955 eggs, 964 larvae (of which 28 were normal) and 19 adults were collected from the treated traps and 310 eggs, 793 larvae (of which 774 were normal) and 14 adults from the controls. No larvae were found in the treated traps after September 1952, no normal ones after August 1952, and no eggs after April 1953. The adults from these traps all died within a fortnight in the laboratory, whereas those from the unsprayed ones survived for the normal period, and it is therefore assumed that the traps can give useful control, even if the beetles are not collected from them. In the sprayed area, the percentage of palms showing fresh attacks increased slightly after July 1951 and reached 40 in September, but it then declined progressively and was only 5·2 in September 1952, 1·2 (the lowest observed) in November 1952, and 3·7 in both May and June 1953; in an unsprayed area, the percentage was 27 in July 1951, 42 in June 1952, 19·5 in January 1953, and 13–14 in May–June 1953.

In laboratory tests with contact insecticides applied against the adults attacking the crowns of the palms, the leaf axils of cut palm crowns were dusted or sprayed with 5 per cent. BHC, DDT or toxaphene and adults of both sexes liberated on them. The BHC spray paralysed over 80 per cent. of the beetles within 24 hours and gave complete kill in a week. The BHC and DDT dusts and the toxaphene spray each gave about 30 per cent. mortality, and the other two treatments were ineffective. When the BHC spray was applied to coconut palms in the field every three months for 19 months, it was washed off by rain and proved of no value. Filling the axils of the leaves with sand alone or mixed with an equal quantity of common salt or 5 per cent. BHC dust was of little value, though the BHC mixture gave some protection in dry weather [cf. **44** 419]; when the concentration of BHC was doubled, the percentage of fresh attacks was reduced from 26 to 12. In a test with repellents in which a tar-oil wash, crude coal tar and a proprietary coal-tar product (Mason mixture) were thickly painted over the inner axils of the leaves, the last two afforded protection for three and four months, respectively, when the weather was dry but for less than a month what it was wet; they cannot therefore be recommended, since heavy rains occur periodically in most coconut-growing areas. Various fermenting liquids proved of no value as attractants for use in poison baits.

Manickavasagar (P.). **A preliminary Study on the Control of Red Bug of Bandakka.**—*Trop. Agriculturist* **111** no. 1 pp. 28–31, 9 figs. Peradeniya, 1955.

The adults and nymphs of *Dysdercus cingulatus* (F.) damage *Hibiscus esculentus* in Ceylon by feeding on the immature pods and shoots, and

occasionally on older pods softened by rain, causing considerable reduction in yield. Tests on control were carried out in 1953–54 during an outbreak on an experimental plot in northern Ceylon. Populations of about eight nymphs and adults per plant were present, and emulsion sprays were applied at about 40 gals. per acre. Rain followed within two days, and there was no apparent control. Sprays were applied again after five days, the concentrations being increased to 0·1 and 0·2 per cent. for DDT, 1·5 and 3 per cent. for dieldrin, 0·4 and 0·9 per cent. for chlordane and 0·06 and 0·1 per cent. for BHC. After a further day, mortality was complete in all plots except those treated with the lower concentration of BHC and those left untreated. There were no phytotoxic effects. Reinfestation occurred within 18 days.

YAMADA (Y.). **Studies on the natural Enemy of the Woollen Pest,** *Anthrenus verbaci* [*sic*] **Linné** (*Allepyris microneurus* **Kieffer**) **(Hymenoptera, Bethylidae).**—*Mushi* **28** pt. 3 pp. 13–30, 2 pls., 2 fldg. graphs, 7 fldg. tables, 28 refs. [Fukuoka] 1955.

The habits of Bethylids are reviewed, and an account is given of observations on the bionomics of *Allepyris microneurus* Kieff., which was found parasitising *Anthrenus verbasci* (L.) in the laboratory in Japan in 1937 and studied in subsequent years. *Anthrenus* is the most important pest of woollen goods in Japan, and had one generation a year [*cf. R.A.E.*, A **25** 675]. The larvae overwintered, and pupae were present in April–June, adults in May and June and eggs in May–July. Larvae of the new generation were present from June onwards and fed until mid-November, most of the damage being caused in autumn. *Allepyris*, all stages of which are described, had two generations a year and overwintered in the prepupal stage in a cocoon. Pupae were present in late June and July, adults and eggs in late July, and first-generation larvae at the end of July and beginning of August. The larvae pupated at the end of that month, giving rise to adults in early September, and these in turn gave rise to second-generation larvae that spun cocoons in the second half of September and overwintered. In the first generation, the egg and larval stages averaged 3 and 2–4 days, respectively, the cocoon was spun in one day, and the adults emerged 26–32 days later. Females survived for an average of 8 days and males for less than 4 days. In the second generation, the egg and larval stages averaged 4 and 3–4 days, respectively, the cocoons were spun in 28–32 hours, and the adults emerged 306 days later. Males and females survived for about 2 and 8 days, respectively. Unfertilised females also oviposited, giving rise to both males and females. When confined with larvae of *Anthrenus*, the females first completely paralysed each in turn, removed the hairs from an area on the abdomen and deposited 1–3 or rarely 4 eggs per larva. The maximum number of eggs laid by one female was 27. Considerably more larvae were paralysed than the numbers required for oviposition. Larvae paralysed by fertilised females died in a shorter time than those paralysed by unfertilised ones. The parasite larvae sucked the fluid from the body of the host and pupated beside its remains.

WATANABE (C.). **On the Japanese Species of the Genus** *Microctonus* **Wesmael with Description of a new Species (Hymenoptera, Braconidae).**—*Mushi* **29** pt. 8 pp. 51–55, 5 figs., 14 refs. [Fukuoka] 1955.

Descriptions are given of the adults of both sexes of *Microctonus punctifrontis*, sp.n., from examples reared from adults of *Psylliodes punctifrons* Baly at Nagano, Japan, together with a key differentiating this and the two other species of the genus that occur in Japan.

Bergman (B. H. H.). **A new Dryinid Parasite of Leafhoppers in Java.**—*Ent. Ber.* **17** no. 1 pp. 9–12, 2 figs., 3 refs. Amsterdam, 1957.

During investigations on Cicadellids on groundnuts near Bogor, West Java [*cf. R.A.E.*, A **45** 87], adults of *Empoasca sundaica* Bergman were found to be parasitised by two unidentified species of *Aphelopus*, one of which is here described from adults of both sexes as *A. maculiceps*, sp. n. A third species of the genus was reared from *E. tripunctula* (Melich.).

van Dinther (J. B. M.). **Scale Insects of *Citrus* in Suriname.**—*Ent. Ber.* **17** no. 1 pp. 13–18, 5 figs. Amsterdam, 1957.

Citrus trees are almost always infested by Coccids in Dutch Guiana, although they are seldom seriously injured in established orchards. The Coccids concerned are *Lepidosaphes beckii* (Newm.), which is usually the commonest, *Fiorinia* sp., *Selenaspidus* sp. and *Chrysomphalus ficus* Ashm., which are less numerous, and *L. gloverii* (Pack.) and *Coccus hesperidum* L., which are scarce. In order to facilitate their recognition, their various stages are described, with references to the pertinent literature.

Beingolea (O.). **Estatus actual de la plaga de la quereza negra del olivo (*Saissetia oleae* Bern) en los valles de Yauca e Ilo.** [The present Status of *S. oleae* on Olive in the Yauco and Ilo Valleys.]—*Bol. trim. Exp. agropec.* **4** (1955) no. 3 pp. 18–22, 2 refs. Lima [1956].

The introduced parasites, *Aphycus* (*Metaphycus*) *lounsburyi* How., *Scutellista cyanea* Motsch. and *Lecaniobius utilis* Comp., afforded excellent control of *Saissetia oleae* (Bern.) on olive in the Yauca and Ilo valleys of southern Peru [*cf. R.A.E.*, A **26** 81] until about 1953, after which small local outbreaks occurred. Investigations in October 1955 showed that the increases were due to excessive humidity of the air and dampness of the soil, which favoured *Saissetia* and were prejudicial to the parasites. These conditions also favoured other Coccids. When irrigation was restricted in the Ilo valley, *S. oleae* was satisfactorily controlled by the parasites and by the predators, *Ectopsocus* (*Peripsocus*) *californicus* (Banks) and *Chrysopa* spp. Of 550 adults of *S. oleae* collected in the Yauca valley, 26·9 per cent. were parasitised by *A. lounsburyi*, 3·27 per cent. by *Scutellista cyanea*, 0·56 per cent. by *L. utilis*, and 3·27 per cent. by a species thought to be *A. flavus* How., which has not previously been recorded from Peru. In this valley, the trees were also rather heavily infested by *Orthezia insignis* Browne, which was heavily parasitised.

In view of the considerable control afforded by natural enemies, treatments with parathion, which is effective against *Saissetia*, are not advised, except where cultural measures, such as the improvement of drainage, replacement of old trees and effective pruning have been proved insufficient. If parathion is used, it should be applied in November–December, and the area later restocked with parasites.

Clarke (J. F. G.). **The Correct Name for a Pest of Cacao (Lepidoptera, Stenomidae).**—*Proc. ent. Soc. Wash.* **56** no. 5 pp. 266–267. Washington, D. C., 1954.

Examination of the types showed that *Zetesima theobromae* Busck [*R.A.E.*, A **8** 232; **9** 536] is a synonym of *Z.* (*Stenoma*) *baliandra* (Meyr.). The species is a serious pest of cacao in Dutch Guiana and Peru, and also occurs in other parts of South America.

Clarke (J. F. G.). **The Correct Name for a Pest of Legumes (Lepidoptera, Olethreutidae).**—*Proc. ent. Soc. Wash.* **56** no. 6 pp. 309–310. Washington, D. C., 1954.

Comparison of specimens of *Epinotia opposita* Heinr. [*R.A.E.*, A **19** 576] with the type of *E.* (*Eucosma*) *aporema* (Wlsm.) showed that the former is a synonym of the latter. This pest attacks lucerne, beans and cowpeas and is stated to occur in Texas [*cf.* **32** 278], Argentina, Costa Rica, Guatemala, Mexico, Peru [*cf.* **31** 477, etc.] and Uruguay [*cf.* also **42** 30, etc.].

Downing (R. S.). **Chemical Control of the Pear Leaf Blister Mite, *Eriophyes pyri* (Pgst.), in British Columbia.**—*Proc. ent. Soc. B.C.* **51** pp. 7–9, 4 refs. Vernon, B.C., 1954.

The results are given of tests in British Columbia on the control of *Eriophyes pyri* (Pgst.) on apple with sprays applied in March or April, at the dormant or pink-bud stage, respectively. Counts on leaves in late summer showed that whether applied with a concentrate sprayer or in high-volume sprays with a hand gun, 12–14 lb. 25 per cent. wettable malathion and 1 quart 42·4 per cent. emulsifiable Systox [diethyl 2-(ethylthio)ethyl phosphorothioate (demeton)] per acre were ineffective at the pink-bud stage, and that 6 and 10 gals. dormant oil gave little control at the dormant stage, whereas 9·2 or 20 gals. lime-sulphur, 7·7 gals. lime-sulphur with 3·8 gals. dormant oil, and 4 lb. 40 per cent. DNC with 6 gals. dormant oil per acre, applied with the concentrate sprayer, and 20 gals. lime-sulphur, alone or with 10 gals. dormant oil, and 7·5 lb. 40 per cent. DNC with 10 gals. dormant oil per acre, in high-volume sprays, gave good control at the dormant stage. The high-volume applications were the more effective, probably because larger amounts of toxicant were applied per acre. The poor control by dormant oil emulsion may have been due to the relatively high viscosity of the oil used (200–220 S.S.U. at 100°F.) or to application before the buds began to open. In a previous test, 7·5 lb. 15 per cent. parathion with 6·5 gals. lime-sulphur per acre at the pink-bud stage also gave poor control.

Downing (R. S.). **Strains of the European Red Mite, *Metatetranychus ulmi* (Koch), resistant to Parathion and Malathion in British Columbia.**—*Proc. ent. Soc. B.C.* **51** pp. 10–11, 3 refs. Vernon, B.C., 1954.

Strains of *Metatetranychus ulmi* (Koch) resistant to phosphorus acaricides appeared in several districts in British Columbia in 1953. Two spray applications of 8 lb. and one of 12 lb. 15 per cent. wettable parathion per acre failed to give control in an orchard in the Oliver district in which two applications of 1 lb. parathion per 100 gals. had been effective in the four previous years, and one spray application of 8 lb. 15 per cent. parathion at the pink-bud stage and one of 4 pints 55 per cent. malathion emulsion concentrate per acre in July were ineffective in a Summerland orchard that had received an average of two parathion sprays per year since 1949.

In the first orchard, single applications of 8 lb. 50 per cent. Ovotran (p-chlorophenyl p-chlorophenylsulphonate), 12 lb. 15 per cent. Aramite (2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite) and 20 lb. 50 per cent. Sulphenone (p-chlorophenyl phenyl sulphone) in July 1953 gave satisfactory control, one of 2 lb. 40 per cent. dinex was effective for two weeks only, and applications of 5 pints 55 per cent. malathion or 8 lb. 15 per cent. parathion were so ineffective that the plots had to be sprayed with other materials a week later. In the second orchard, 1 lb. 19 per cent.

Mildex (wettable dinitrocaprylphenylcrotonate and related nitrogen derivatives) per 100 gals. gave moderate control in August, but 1 lb. 15 per cent. parathion was ineffective.

Resistance was also observed in an orchard in the Picton area, in which 0·66 pint 55 per cent. malathion per 100 gals. did not control the mite, whereas 3 lb. 40 per cent. Sulphenone per 100 gals. did.

Proverbs (M. D.). **Chemical Control of Aphids in British Columbia Orchards.**—*Proc. ent. Soc. B.C.* **51** pp. 23–30, 7 refs. Vernon, B.C., 1954.

Various sprays were tested in 1947–53 for the control of Aphids that infest fruit trees in the interior of British Columbia. It was found that the standard summer spray of nicotine sulphate and soap could not be applied effectively with concentrate sprayers because of excessive foaming, but concentrated sprays of nicotine sulphate and washing soda (sodium carbonate) at rates of 1 quart and 1 lb., respectively, per acre proved effective against *Hyalopterus pruni* (Geoffr.) (*arundinis*, auct.) on prune. Polyethylene glycol esters of oleic acid and an oil did not measurably enhance the value of nicotine or nicotine sulphate against this or other species. Parathion at 0·75 lb. 15 per cent. wettable powder per 100 gals. proved as effective as nicotine sulphate and soap against *Anuraphis cardui* (L.) on prune and more effective than nicotine sulphate against light infestations of *H. pruni* on prune and *Myzus cerasi* (F.) on cherry, but it was injurious to predacious Coccinellid and Syrphid larvae, and the deposit killed adults of the parasites, *Aphidius testaceipes* (Cress.) and *Ephedrus nitidus* Gah. emerging from *M. cerasi*. It was as effective as nicotine sulphate against *M. persicae* (Sulz.) on peach at 1 lb. 15 per cent. powder per 100 gals. and nearly as effective against *Eriosoma lanigerum* (Hsm.) on apple at 3 lb. 25 per cent. wettable powder alone or with oil. Parathion was replaced in 1953 by malathion, which was much more effective at 16 lb. 25 per cent. concentrate per acre than nicotine sulphate against *H. pruni* on prune and *Aphis pomi* Deg. on apple and at 2 lb. per 100 gals. against *M. persicae* on peach; it also readily controlled *E. lanigerum*, *Anuraphis cardui* and *M. cerasi*, but sometimes injured cherry foliage. It is recommended only against heavy infestations, however, owing to its toxicity to predators.

BHC gave better control with oil than without it. Control of *E. lanigerum* was improved by increasing the concentration from 0·125 to 0·25 lb. γ BHC per 100 gals., but this involved risk of tainting the fruits. HETP [hexaethyl tetraphosphate] also controlled *E. lanigerum* and *Aphis pomi*, but it injured some varieties of apple. Concentrated sprays of 2 quarts 40 per cent. emulsifiable Pyrolan (1-phenyl-3-methyl-5-pyrazolyl dimethylcarbamate) or 1 quart 18·5 per cent. emulsifiable endrin or isodrin per acre gave good immediate but poor residual mortality of *E. lanigerum*. Pyrolan proved very effective against *H. pruni* on apricot at double this dosage in a high-volume spray and should be tested further. Emulsifiable Pyrenone T-503 (0·4 per cent. pyrethrins, 2 per cent. rotenone and 4 per cent. piperonyl cyclonene) gave variable results against *H. pruni* on prune and apricot and was ineffective against *E. lanigerum*. Isopestox (bis(monoisopropylamino) fluorophosphine oxide) was very effective against *E. lanigerum* when applied a few weeks before harvest at 6 lb. per acre in a concentrated spray, but was considered too dangerous for use, and schradan at 1 gal. 63·3 per cent. emulsifiable liquid per acre did not give satisfactory control of *A. pomi* when applied about a month before harvest.

Since dormant sprays against Aphid eggs are sometimes difficult to apply, the effectiveness of petal-fall applications designed to kill the fundatrices

before they reproduce was investigated in 1949. A petal-fall spray of 0·75 lb. 15 per cent. wettable parathion per 100 gals. proved as effective against *M. cerasi* as the same spray or one of 1·5 lb. 40 per cent. DNC, 2 gals. oil and 0·5 lb. soy-bean flour per 100 gals. applied at the dormant stage, and more so than a petal-fall spray of nicotine sulphate and soap, maintaining control throughout the season.

PROVERBS (M. D.). **Chemical Control of the Peach Twig Borer, *Anarsia lineatella* Zell. (Lepidoptera: Gelechiidae), in the Okanagan Valley of British Columbia.**—*Proc. ent. Soc. B.C.* **51** pp. 31–36, 1 ref. Vernon, B.C., 1954.

Anarsia lineatella Zell. is an important pest of peach and apricot in the Okanagan valley of British Columbia. It has two generations a year; the immature larvae overwinter in excavations in the bark, usually in crotches between one- and two-year-old wood, emerge from hibernation when the flower buds of peach reach the balloon stage, and feed in the twigs. Larvae of the summer generation feed on both twigs and fruits. Lime-sulphur and lead arsenate have been applied against the overwintered larvae, but they sometimes injure the trees, and newer insecticides were therefore tested in 1947, 1948 and 1952.

In 1952, 50 per cent. wettable DDT, applied to peach at 16 lb. per acre in sprays at the late balloon-bud or petal-fall stages (24th April and 12th May, respectively) gave better control than the usual balloon-bud spray of lime-sulphur, did not cause any noticeable increase of phytophagous mites and was probably harmless to adults of *Paralitomastix pyralidis* (Ashm.), which do not emerge from the parasitised larvae until about a month after petal-fall. Sprays of 1 gal. dormant oil (viscosity about 220 S.S.U. at 100°F.) per 100 gals. containing 0·25 lb. γ BHC or 3 gals. lime-sulphur and of 1–2 gals. distillate oil (viscosity about 40 S.S.U.) per 100 gals. containing about 0·25 lb. γ BHC, applied to apricot or peach at the delayed-dormant stage (12th March 1947 and 1st or 2nd April 1948), gave fairly good control in three of four orchards, but were not so effective as lime-sulphur at the balloon stage. The spray of oil and lime-sulphur killed many of the larvae after they had emerged from hibernation, whereas oil with BHC killed most of them before, and it is presumed that BHC was largely responsible for the lethal effect, the oil acting mainly as a vehicle to bring it in contact with the hibernating larvae. The BHC treatment has not been recommended, as the petal-fall spray of DDT is very effective and also controls species of *Lygus*. A delayed-dormant spray of oil, DNC and soy-bean flour gave satisfactory control on peach and apricot in 1947–48 but injured apricot buds; without soy-bean flour, it was very injurious to peach. A balloon-bud spray of 7·5 lb. 15 per cent. wettable parathion per acre was effective on peach in one test, but it was not investigated further because of toxicity to man. A similar spray of 0·25 gals. emulsifiable 42·4 per cent. Systox [diethyl 2-(ethylthio)ethyl phosphorothioate (demeton)] per acre was not quite as effective as lime-sulphur.

MORGAN (C. V. G.), CHANT (D. A.), ANDERSON (N. H.) & AYRE (G. L.). **Methods for estimating Orchard Mite Populations, especially with the Mite Brushing Machine.**—*Canad. Ent.* **87** no. 5 pp. 189–200, 7 figs., 10 refs. Ottawa, 1955.

Phytophagous mites have increased in importance in orchards in British Columbia, and the authors here review the various methods developed for the estimation of populations, with their advantages and disadvantages

[*cf. R.A.E.*, A **26** 283; **30** 134; **31** 471; **32** 115; **37** 246; **41** 426; **42** 306], and describe one devised in 1949 for counting the winter eggs of *Metatetranychus ulmi* (Koch) and *Bryobia praetiosa* Koch. The sampling unit consists of a fruit spur with a short piece of shoot attached. The samples are soaked for 30 minutes in benzene, which is then heated almost at boiling point for 20 minutes and vigorously stirred to dislodge the eggs, after which the samples are removed. The benzene is cooled and filtered and the residue washed into a beaker containing water and sodium lauryl sulphate; any eggs still on the spurs are brushed into this solution, which is made up to a specified volume and agitated. An aliquot is then drawn off and filtered, and the eggs on the filter paper are counted before it dries. Egg density can be assessed as the number per fruit spur or per unit area of fruit spur, and a formula for the calculation of the surface area of the spur is given. It was later found that the eggs can be readily removed by soaking overnight in a solution of 1·5 per cent. sodium hypochlorite with the addition of one drop of concentrated sodium lauryl sulphate per 25 ml.

A brushing machine [**31** 471] is stated to provide the best method for rapid estimation of phytophagous and predacious mites, especially if they are very numerous or small, and information is given on improved adhesives and counting disks for use with it. It permitted the recovery of all the active stages of *M. ulmi* and *B. practiosa* and 98·8 per cent. of the eggs from apple leaves; it also proved effective for *Eotetranychus carpini borealis* (Ewing), which spins a moderate amount of web, and enabled more accurate estimates of the numbers of eggs and active stages of two predacious mites, *Mediolata terminalis* (Quayle) and *Typhlodromus rhenanus* (Oudm.), on apple leaves to be made than did direct counts under a low-power microscope. Eriophyid mites, of which there may be over a thousand per leaf, were satisfactorily removed by the machine, but the subsequent counting was laborious; counts can be restricted to one or two sections per disk, and the selection of these is illustrated by reference to practical tests with *Vasates schlechtendali* (Nal.). The distribution pattern is likely to be different for each species. *B. practiosa* occurs on bark as well as on foliage, and all the active and resting stages and 93 per cent. of the summer eggs were successfully removed by the machine; winter eggs were too firmly attached.

Leech (H. B.). **Cheesecloth Flight Traps for Insects.**—*Canad. Ent.* **87** no. 5 p. 200, 1 ref. Ottawa, 1955.

The trap described, which is effective in sunlight in wooded areas, consists of a wooden framework to which cheesecloth is tacked to form a south wall 6 ft. × 6 ft. in size and short east and west walls and top, the back is open except for a fringe about 1 ft. long hanging from the top. It is set up with the open back away from the sun, and the insects are attracted to the south wall, on which they rest, by the light shining through it; most remain in the trap as long as the sun is shining, and the short sides and fringe tend to prevent escape.

Loan (C.) & Holdaway (F. G.). **Biology of the Red Clover Thrips, *Haplothrips niger* (Osborn) (Thysanoptera: Phloeothripidae).**—*Canad. Ent.* **87** no. 5 pp. 210–219, 22 figs., 6 refs. Ottawa, 1955.

Haplothrips niger (Osb.), of which all stages are described and the world distribution noted, commonly damages the flowers of red clover (*Trifolium pratense*) and alsike clover (*T. hybridum*) grown for seed in Minnesota, up to 50–80 adults occurring in individual flower heads. Observations on

the bionomics of the thrips were carried out in Minnesota in 1952 and Ontario in 1953. The results showed that one complete generation and a partial second are produced each year. Reproduction was parthenogenetic, and no males were seen [*cf. R.A.E.*, A **42** 174]. In the laboratory, the preoviposition period lasted 2–9 days at 25°C. [77°F.], and the eggs were laid within the well-developed florets, between the small, undeveloped florets, and between the points of the calyx and the base of the corolla on white clover (*T. repens*), and on the lower centre of the standard petal, between the keel and wing petals, and among the anthers of lucerne. The mean durations of the egg, first nymphal, prepupal and first and second pupal instars were 4·6, 6, 1·5, 1·4 and 3·7 days, respectively, in the laboratory at 25°C. and 10–12, 6–12, 2–5, 2–3 and 3–7 days, respectively, in the insectary. The second-instar nymphs usually enter diapause when fully developed and overwinter in the soil, but in those that did not, this stage lasted 6–9 days at 25°C. Of 200 fully developed second-instar nymphs collected in Ontario between 30th June and 6th July, 54 pupated in the same year. The nymphs feed on the pollen grains and floral tissues, and pollen was also the preferred food of the adults, but was not essential for the maturation of the ovaries, since females that fed on white-clover leaves oviposited normally. At 25°C., the total and mean daily numbers of eggs laid per female were 3–55 and 1·2, respectively; fewer eggs were laid under insectary conditions. Adults of the overwintered generation appeared in early May and survived for up to 6–8 weeks. First-instar nymphs of the first generation were present in the flower heads in early June, and second-instar nymphs that pupated in the same year did so in early July, in the flower heads; no pupae were found after 20th July in either year. First-generation adults were present from early July until late September, and nymphs of both the first and second generations were present in the mature flower heads until late autumn.

List (G. M.) & Sylvester (E. S.). **The Relationship of Aphids to a toxicogenic Disease known as Aphid-yellows of Celery.**—*Tech. Bull. Colo. agric. Exp. Sta.* no. 50, 15 pp., 9 figs., 3 refs. Fort Collins, Colo., 1954.

The following is based almost entirely on the authors' summary. A disease for which the name "Aphid-yellows of celery" is suggested has caused severe damage to celery in Colorado since 1940. The disease is characterised by stunting of the heart leaves, twisting, splitting and recurvature of the pithy petioles, prostration and a general chlorosis accompanied by discoloration. The symptoms resemble those caused by California or western aster-yellows, a virus disease that is transmitted by *Macrosteles fascifrons* (Stål), but were not induced by the feeding of *M. fascifrons* taken from plants infected with aster-yellows and caged on celery or by mechanical inoculation of virus.

In the field, the disease is always associated with infestation by *Aphis heraclella* Davis [*cf. R.A.E.*, A **27** 590], and it can be experimentally produced by the feeding of this Aphid, symptoms appearing in 10–35 days, depending on the size of the initial Aphid population and the rate of colony increase. Sectioning of affected leaflets showed that the Aphid feeds largely in the region of the phloem. Diseased plants recover if freed from the Aphid, and such plants produce viable seed, but reinfestation results in a renewal of the symptoms. The preponderance of evidence indicates that the causative agent is not a virus, but is of toxicogenic origin, and that the capacity to produce it is inherent in *A. heraclella*. Morphologically, this Aphid cannot be clearly distinguished from *A. helianthi* Monell. *Cornus* is the winter food-plant of *A. helianthi*, and apparently also of *A. heraclella*,

but their summer food-plants appear to be distinct. They are therefore considered to be distinct species. *A. heraclella* can be controlled by timely applications of the standard aphicides.

Smith (C. E.) & Weber (J. C.). **The Legume Mite, *Petrobia (Tetranychina) apicalis* (Banks), a Pest on several Winter Growing Legumes.**—*Tech. Bull. La agric. Exp. Sta.* no. 493, 25 pp., 5 figs. [Baton Rouge, La.] 1954.

Petrobia apicalis (Banks) is a serious pest of clovers, vetches (*Vicia*) and winter pea (*Lathyrus hirsutus*) in Louisiana. It is active from about November to May, a generation lasting 12–18 days in the laboratory, and passes the summer as a diapause egg, which is protected by a cup-shaped receptacle with a lid. These summer eggs are laid in large numbers, preferably on rough surfaces, such as in cracks, under loose bark, or on trees, bushes, fences, or walls, whereas the winter eggs are laid chiefly on the food-plants. The mites feed mainly on the upper surfaces of the leaves, and severely damaged plants are unappetising as forage and produce little or no seed. Experiments on control in 1949–54 showed that numerous toxicants were effective against this Tetranychid. Those recommended for application to the plants are malathion at 0·5 lb. per acre in an emulsion spray, 0·25 lb. demeton (diethyl 2-(ethylthio)ethyl phosphorothioate) or schradan in 6 U.S. gals. or more spray per acre, a dust of 1 per cent. parathion at 15–20 lb. per acre, TEPP which is effective against the mites contacted by the spray, but has no effect on the eggs or quiescent forms, Aramite (2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite) at 0·5 lb. per acre in a spray, and dusts of sulphur alone or with 1 per cent. dinex, which are slow-acting and not effective at temperatures below about 70°F. Sprays of oil or oil emulsion successfully controlled summer eggs on posts.

Jewett (H. H.), Buckner (R. C.) & Fergus (E. N.). **Control of *Miris dolabratus* (Linn.) and *Amblytylus nasutus* (Kirsch.) on Kentucky Bluegrass.**—*Bull. Ky agric. Exp. Sta.* no. 621, 14 pp., 3 refs. Lexington, Ky., 1954.

The following is based on the authors' summary. *Amblytylus nasutus* (Kirschb.) and *Miris dolabratus* (L.) are important pests of Kentucky blue grass [*Poa pratensis*] grown for seed in Kentucky [*cf. R.A.E.*, A **39** 57], the former every year and the latter in some seasons only. Tests on control were made in 1949–53, and the results, which are given in tables, indicated that sprays of DDT, DDD (TDE), chlordane, aldrin, toxaphene, BHC and parathion were effective against these Mirids at suitable concentrations, with little difference between them. The materials recommended are γ BHC, aldrin and toxaphene in emulsion concentrates at 4, 6 and 24 oz. toxicant per 5–10 gals. water, respectively; the residues will normally have disappeared from treated fields by the time of seed stripping, so that the fields can then safely be grazed. The best time for spraying is about 10th May, after most of the overwintered eggs have hatched and before the adults appear, and only one application is necessary.

Frick (K. E.), Simkover (H. G.) & Telford (H. S.). **Bionomics of the Cherry Fruit Flies in eastern Washington.**—*Tech. Bull. Wash. agric. Exp. Sta.* no. 13, [2+] 66 pp., 34 figs., 65 refs. [Pullman, Wash.] 1954.

Cherries in eastern Washington are infested by *Rhagoletis cingulata* (Lw.) and *R. fausta* (O.-S.), and investigations on the bionomics and ecology of

these fruit-flies were carried out in 1949–53 and 1952, respectively. The following is based on the authors' summary of the results.

Adult emergence of *R. cingulata* in the Yakima Valley began as early as the third week of May and continued until mid-July, the overwintered pupae requiring about 26 days at 80°F. to complete their development. The presence of a cover crop in the orchard delayed the date of 50 per cent. emergence by as much as ten days, owing to the lower soil temperatures. Peaks of emergence usually followed 1–3 days after peaks in daily mean temperature, and males comprised 54 per cent. of the adults that emerged in cages. The daily numbers of adults attracted to baits of ammonium carbonate were used as a measure of fruit-fly activity [*cf. R.A.E.*, A **40** 234]. This was reduced by cool or stormy weather or a mean temperature above 72·5°F. A temperature of 100°F. killed all adults within five days. More adults were found on the north sides of the trees on warm days and on the south sides on cool days, and more occurred in the lower than in the upper halves of the trees.

The preoviposition period [*cf.* **43** 414] varied with temperature and fruit maturity. When ripe cherries were available, it lasted five days at 80–90°F., six days at 75°F., ten days at 65°F. and 21 days at 60°F. Females kept at 55°F. did not oviposit. The oviposition period lasted up to 36, 59, 34, 91 and 82 days at 90, 85, 80, 65 and 60°F., respectively, and ranged from nine to 49 days for seven examples kept individually at 80°F. The average number of eggs deposited at 80°F. was 386, the extremes being 875 and 24; the average at 65°F. was 99, and that at 60°F. 17. The adults survived for up to 30 days in the orchard, but for only some 15 days if the average temperature exceeded about 72°F. At room temperature, males and females lived for averages of 23 and 30 days, respectively. The maximum survival periods at constant temperatures of 90, 85, 80, 65, 60 and 55°F. were 73, 88, 110, 135, 183 and 117 days.

The eggs are deposited in slits made through the skin of the cherries, and they hatched in 5–8 days, with an average of six days. The larval stage averaged 11 days at 77°F., the extremes being 8 and 14 days. The larvae failed to mature at 55°F., and all development ceased at 40°F. Exposure for two weeks to 32–40°F. was lethal to all first- and second-instar larvae, and 22 days at such temperatures killed 75 per cent. of all larvae. Pupation occurred 4–8 hours after the larvae left the fruits, about 60 per cent. of individuals pupating in the upper inch of uncultivated soil and about 33 per cent. in the second inch. Cultivated soil was penetrated more deeply, 21, 55 and 22 per cent. of the larvae pupating in the first three inches, respectively. There was some lateral dispersion (up to a foot) of larvae seeking entrance sites. Most of the pupae overwintered, and laboratory tests showed that 150 days at 32–40°F. resulted in maximum subsequent emergence. Soil cultivation increased pupal mortality by about 10 per cent., but the adults were able to emerge from a depth of 36 ins. in loose sandy soil in tubes. Some adults emerged in the current season, but after cherries were available for oviposition. The adults dispersed from the orchards to surrounding trees and shrubs, marked individuals being recovered up to 135 ft. from a release tree in the same orchard and one in a trap 220 ft. away [*cf.* **44** 390]. Dispersion across open fields was slight, but some adults moved 600 yards through a pear orchard.

The bionomics of *R. fausta* were similar, but the adults emerged about a week earlier in spring than did those of *R. cingulata*. Larvae of both species were parasitised by *Phygadeuon epochrae* Vier., and those of *R. cingulata* also by *Opius* sp., *O. ferrugineus* Gah., *O. rosicola* Mues., *Tryblio-graplia* sp., *Tetrastichus faustus* Burks, *Pachycrepoideus dubius* Ashm., *Halticoptera* sp., *Eupteromalus* sp. near *americanus* Gah., and *Psilus* sp. Although parasitism ranged up to 50 per cent. in wild cherries, it did not

exceed 3 per cent. in cultivated varieties, the fruits of which are probably too large for the ovipositors of the parasites to reach the feeding larvae.

Blanc (F. L.) & Keifer (H. H.). **The Cherry Fruit Fly in North America. Morphological Differentiation between the eastern and western Subspecies of the Cherry Fruit Fly,** *Rhagoletis cingulata* (**Loew**).—*Bull. Calif. Dep. Agric.* **44** no. 2 pp. 77–88, 13 figs., 42 refs. Sacramento, Cal., 1955.

The authors describe characters of the third-instar larvae and the adults permitting examples of the cherry fruit-fly, *Rhagoletis cingulata* (Lw.), from the east of the United States to be distinguished from those in the Pacific Northwest [*cf. R.A.E.*, A **42** 163, etc.]. The differences are considered to warrant subspecific status, and the name *R. cingulata indifferens* Curr. is applied to the north-western subspecies, that in the east being the typical one. Populations in certain mountainous areas of California may represent a third group. Typical *cingulata* is recorded from the eastern and mid-western United States and adjacent areas of Canada and subsp. *indifferens* from British Columbia, Idaho, Washington, Oregon and mountains of northern California. Cultivated cherries are attacked by both, *Prunus serotina* by typical *cingulata*, and *P. emarginata* by subsp. *indifferens*.

Madsen (H. F.) & DeTar (J. E.). **Leaf Curl Plum Aphid Control. Tests in 1954 Season developed Spray Treatments against Insect Pest of sudden Economic Importance.**—*Calif. Agric.* **9** no. 1 pp. 8, 13, 3 figs. Berkeley, Cal., 1955.

An outbreak of *Anuraphis padi* (L.) (*helichrysi* (Kalt.)) occurred on plum in Placer County, California, in the spring of 1953, and observations in that and the following year showed that the fundatrices hatched about the time the buds began to swell and gave rise to several generations of Aphids that infested the young leaves, causing curling. Alates appeared in June or July and left the trees; the summer food-plants were not determined. The return migration to plum occurred in November. In tests, good control of the winter eggs was given by a dormant spray of a dinitro compound in oil emulsion or by a delayed-dormant spray of DN 289 [dinoseb (triethanolamine)]. Parathion, malathion, and nicotine sulphate with oil were very effective in sprays at the cluster-bud stage against the early-hatched Aphids, but petal-fall treatments proved unsatisfactory as the leaves were already curled and the Aphids consequently protected by them.

Ortega (J. C.). **Codling Moth Control Sprays. New Insecticides tested in Field Investigations in southern California for Effectiveness against several Pests of Walnuts.**—*Calif. Agric.* **9** no. 5 pp. 6, 14. Berkeley, Cal., 1955.

Details are given of tests in southern California in May 1954 showing that Diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate] applied by air-carrier equipment in sprays at 3 lb. in 400 U.S. gals. per acre was as effective as DDT at a comparable dosage for the control of the codling moth [*Cydia pomonella* (L.)] on walnut and highly toxic to the European red mite [*Metatetranychus ulmi* (Koch)] and the walnut Aphid [*Chromaphis juglandicola* (Kalt.)].

Hinrichs (H. A.) & Thomson (H. J.). **Insecticide Tests for Pecan Weevil Control.**—*Bull. Okla. agric. Exp. Sta.* no. B-450, 12 pp., 5 graphs. Stillwater, Okla., 1955.

Curculio caryae (Horn) is a harmful pest of pecan in Oklahoma, the adults feeding on the nuts externally and causing shedding, and the larvae developing within the nuts and destroying them. The life-cycle of the weevil lasts 1–3 years, mostly two years, the adults emerging from the soil in July–October and the larvae becoming full-fed in September–November and forming cells in the soil in which they pupate in the same autumn, or in the next, or occasionally in the one after that. Tests in 1947–50 showed that DDT is effective against the adults, and a spray of 4 lb. 50 per cent. wettable powder per 100 U.S. gals. is recommended. The dates suggested are 10th August and again after a subsequent heavy rain, which hastens emergence of the adults from the soil, this second spray to be applied not later than 1st September.

Miller (W. E.) & Neiswander (R. B.). **The Biology and Control of the European Pine Shoot Moth.**—*Res. Bull. Ohio agric. Exp. Sta.* no. 760, 31 pp., 7 figs., 29 refs. Wooster, Ohio, 1955.

The following is substantially the authors' summary. *Rhyacionia buoliana* (Schiff.) is the principal insect pest of red pine (*Pinus resinosa*) in northern Ohio, causing deformity of the trees by severing the needles and boring in the buds and shoots. Swiss mountain pine (*Pinus mugo*) and Scotch pine (*Pinus sylvestris*) are also attacked. Observations on its bionomics showed that the eggs are laid during the latter half of June and early July and hatch in about nine days. The larvae wander over the shoot for several hours and then feed at the base of the needles, later feeding in the buds. They overwinter mostly in the fourth instar and resume activity in April, when one or more new buds are attacked and shoots are tunnelled as they develop. Pupation occurs in the larval tunnels during late May and early June, the adults emerging mostly during the last three weeks of June. Mortality of the larvae commonly reaches 65–85 per cent., but low winter temperatures only temporarily reduce the population [*cf. R.A.E.*, A **43** 313]. Several parasites attack the larvae, but none in sufficient numbers to give control.

In control experiments carried out in 1950–53, sprays were more effective than dusts, and the best results were obtained when sprays were applied with power ground equipment, treatment from aircraft being inferior [*cf.* **43** 47]. One application of DDT at 1 or 2 lb. per 100 U.S. gals. [*cf.* **42** 94] resulted in excellent control if applied in mid-April, when the larvae were resuming feeding, or in late June or early July, when the eggs are hatching. Red-pine plantations that grow normally reach a stage in 7–9 years in which infestation by *R. buoliana* becomes unimportant. The number of spray applications needed for control during this period may vary from one to five, depending on the efficiency of the application and the sources of reinfestation.

Miller (W. E.). **Notes on the Life Cycles of three Parasites of the Pitch Twig Moth.**—*Ohio J. Sci.* **55** no. 5 pp. 317–319, 4 refs. Columbus, Ohio, 1955.

Petrova comstockiana (Fern.) feeds on the current growth of pines in Ohio and has one generation a year, the larvae overwintering and giving rise to adults in May and June. The larvae were found to be parasitised by *Agathis pini* (Mues.), *Hyssopus thymus* Gir. and *Ephialtes* (*Calliephialtes*) *comstockii* Cress. *A. pini* was the most important. Larvae of this Braconid

were observed from July within their hosts, and they became full-fed in the following May, when they left their hosts and pupated in the burrows made by the latter. The pupal stage lasted 10–21 days and averaged 15 days. The parasitised larvae survived until they had completed the normal exits for the adults, which were later used by the emerging adults of *Agathis*. All *Petrova* larvae found after 1st May were parasitised by *Agathis*. Many larvae of *A. pini* were themselves parasitised by *Perilampus fulvicornis* Ashm., larvae of which were found attached externally to the *Agathis* larvae. These latter did not survive to pupate Adults of the hyperparasite emerged in June; there was one generation a year, about ten months being spent in the first larval instar. The larvae of *H. thymus* were ectoparasitic and gregarious. They overwintered in the pupal stage in the host burrows, and adults emerged on 6th–22nd April in 1953. Adults of the next generation emerged from 25th May to 3rd June, and there appeared to be at least another partial generation of the Eulophid before hibernation set in. In the overwintering generation, 1–6 pupae (with an average of 2·5) were found per host larva, and in the summer there were 1–19 pupae or full-fed larvae (average 10) per host. Both males and females developed on one *Petrova* larva. The pupal stage in the summer generation lasted 18–23 days and averaged 20 days.

Perry (C. C.). **Gypsy Moth Appraisal Program and proposed Plan to prevent Spread of the Moths.**—*Tech. Bull. U.S. Dep. Agric.* no. 1124, [2+] 27 pp., 4 figs., 8 refs. Washington, D.C., 1955.

The following is based on the author's summary. An appraisal of the situation with respect to *Lymantria* (*Porthetria*) *dispar* (L.) in the United States was undertaken in 1952 for the purpose of developing a co-ordinated and detailed plan for the control or eradication of this insect, in co-operation with State governments. The appraisal comprised a survey to determine the limits of the generally infested area in New England and New York, a study of the losses caused by the moth in killing trees, retarding growth and impoverishing forest stands, and an ecological study to determine the susceptibility of stands in the extensive hardwood forests outside the infested area.

The survey showed that the infested area comprised about 29½ million acres [*cf. R.A.E.*, A **44** 164], the population varying in density from very light to very heavy. The study of damage included a review of previous research, the examination of 84 susceptible areas within the generally infested territory, and the co-ordination of individual reports. The financial losses for the period 1933–52 in New England due to mortality of forest trees and inhibited growth were estimated at almost 4¼ and 2½ million dollars, respectively. In addition to these direct losses, there were intangible losses due to damage to sites and to the future production of timber and reduction of recreational values. These at least equalled and probably exceeded the losses due to the more tangible forms of damage. A special survey of forest areas south and west of the infested region showed the existence of about 100 million acres of oak woodlands highly susceptible to damage should the moth become established in them.

The programme adopted as a result provided for the establishment of a barrier zone along the periphery of the regulated area, the operation of co-operative surveys and spraying operations within and to the east of the barrier zone, co-operative trapping surveys to the west and south of the zone, limited technical assistance to States within the infested area in the development of control techniques, strengthening of quarantine operation, an improved educational programme, and further studies on the epidemiology

of the insect. The programme was approved in September 1953, and initial steps were taken to put it into operation.

Clausen (C. P.). **Biological Control of Insect Pests in the continental United States.**—*Tech. Bull. U.S. Dep. Agric.* no. 1139, vi + 151 pp., 1 map, 152 refs. Washington, D.C., 1956.

The biological control of numerous insect pests has been attempted in the United States, either by the introduction of natural enemies from abroad or by the dissemination of those already present, and the results are surveyed in this bulletin. Brief introductory discussions relating to the worldwide search for suitable species, the organisations taking part in the work, the use of micro-organisms and native insects for control, the effect of insecticides and of ants on natural enemies, and methods of mass breeding are followed by a list of 91 pests against which operations have been directed. The great majority are insects that attack fruits, field and garden crops or forest, shade or ornamental trees and shrubs, and notes are given on their local distribution and importance and on releases of parasites or predators that have been made against them. This is followed by a list of 95 parasites and predators that have become established, with information on their origin, hosts and habits, the dates and localities of liberation, and their effectiveness as control agents.

Selhime (A. G.). *Brumus suturalis*, **a beneficial Lady Beetle.**—*Florida Ent.* **39** no. 2 pp. 65–68, 6 figs., 2 refs. Gainesville, Fla., 1956.

Brumus suturalis (F.), which occurs in countries of the Far East and Tanganyika and feeds on mites and Hemiptera [*cf. R.A.E.*, A **32** 406], was introduced into Florida from Pakistan and reared in the laboratory. Its life-cycle lasted 19–31 days, depending on temperature and food-supply, and it fed on mixed colonies of *Aphis spiraecola* Patch, *A. gossypii* Glov. and *Toxoptera aurantii* (Boy.), two species of *Macrosiphum* from wild plants, *Planococcus citri* (Risso), *Coccus viridis* (Green), eggs and larvae of *Dialeurodes citri* (Ril. & How.) and *D. citrifolii* (Morg.) and eggs of *Metatetranychus citri* (McG.). Releases were made in *Citrus* groves mostly in Orange and Lake counties, those selected being unsprayed and consisting so far as possible of Temple orange and tangerine, which furnish a better supply of Aphids than other varieties, and the Coccinellid was also forwarded to other centres for testing.

Denmark (H. A.). **The Mediterranean Fruit Fly infests Florida again: early Chronology.**—*Florida Ent.* **39** no. 2 pp. 85–87. Gainesville, Fla., 1956. . . . **Second Report.**—*T. c.* no. 4 pp. 175–176.

Details are given of the recent spread of *Ceratitis capitata* (Wied.) in Florida [*cf. R.A.E.*, A **44** 418, etc.] from its first discovery (in grapefruit) in April 1956 to 24th August of that year, by which date infestations had been found on 1,384 properties in 27 counties, with notes on the various protective measures adopted.

Cressman (A. W.), Yust (H. R.) & Eichorn (D.). **Gastight Fabrics for Use in Fumigating with Hydrocyanic Acid Gas.**—*Circ. U.S. Dep. Agric.* no. 978, [1+] 14 pp., 3 figs., 7 refs. Washington, D.C. [1956].

The following is virtually the authors' summary. Plastic-coated gas-tight fabrics for tent-fumigation of deciduous trees with hydrogen cyanide were

extensively tested in work against the Hall scale [*Nilotaspis halli* (Green)] in California [*cf. R.A.E.*, A **44** 327] and may also prove useful for other purposes. Important physical properties were strength, weight, weave of the base cloth, flexibility, abrasion resistance of the coating, adhesion between cloth and coating, permeability, and stability to ageing and weathering. A tearing strength of 8 lb. in the finished material was adequate for deciduous tree fumigation. The strength of the uncoated cloth should be greater, since there is always some loss in coating. The ideal weight was about 8·5 oz. per sq. yard. Weaker and lighter materials might be suitable for other uses. Abrasion resistance depended on both the toughness of the plastic film and adhesion between coating and cloth. Good adhesion was necessary to prevent peeling of coatings from smooth fabrics. Instability toward ageing and exposure to weather was reflected in increasing stiffness and permeability. Many materials that were initially gas-tight deteriorated rapidly on exposure. This property was checked by roof exposure and weatherometer tests of candidate materials, followed by tests of permeability. Cotton cloth required a rather heavy coating to seal it against gas loss, and the strength-weight ratio was unsatisfactory for field use. Glass fibre cloth was superior to cotton in some respects, but the physical properties of the glass fibre made the coated material break down after several years' use. The advantages of nylon cloth included strength, resistance to rot and mildew, and ease of sealing with a light coat of plastic. The effect of sunlight on nylon was decreased by coating. A dispersion of vinyl-chloride vinyl-acetate copolymers of high molecular weight with mixed phthalate and phosphate plasticisers on nylon cloth made the most satisfactory fabric. An adhesive was necessary to bond coating and cloth. Fumigation tents of this material remained gas-tight or nearly gas-tight through 5 years of use. Copolymers of lower molecular weight and various polyvinyl-chloride and other plastic coatings were less durable.

Bailey (S. W.). **Air-tight Storage of Grain; its Effects on Insect Pests. I.** *Calandra granaria* **L. (Coleoptera, Curculionidae).**—*Aust. J. agric. Res.* **6** no. 1 pp. 33–51, 9 figs., 25 refs. Melbourne, 1955. **II.** *Calandra oryzae* **(Small Strain).**—*Op. cit.* **7** no. 1 pp. 7–19, 5 graphs, 10 refs. 1956.

The storage of grain in air-tight containers has given good control of insect infestation in different countries, and hermetically sealed pits have given good results in Argentina [*cf. R.A.E.*, A **41** 380] and East Africa [*cf.* **44** 136]. Insect mortality has generally been attributed to the accumulated carbon dioxide [*cf.* **7** 383; **8** 178; **41** 380], and the effects of this factor and of oxygen depletion on species of *Calandra* were investigated in laboratory experiments described in these two papers.

The first contains an account of the experimental procedure and of the results obtained with *C. granaria* (L.). The apparatus was submerged in a water-bath kept at 25°C. [77°F.] and consisted of a glass tube 2 ft. long, through which a stream of nitrogen, carbon dioxide and oxygen was passed. This originated from a constant-flow gas-mixing apparatus designed to produce any desired mixture, and its temperature and relative humidity were maintained at 25°C. and 72 per cent., respectively. The test insects were laboratory-reared adults that had emerged not more than a week previously. Batches of ten were placed with about 11 gm. wheat containing 14·2 per cent. moisture in each of ten containers with top and ends of wire gauze and exposed in the tube, and each experiment lasted for five weeks, which was approximately the duration of the life-cycle under the conditions provided. Mortality counts of weevils in successive containers were made

twice a week, and those capable of movement were kept at 25°C. and 70 per cent. relative humidity in room air for 48 hours so that delayed mortality or revival could be determined; the grain from which they had been removed was sieved twice weekly, and the F_1 eggs and adults counted. Some experiments were also carried out with grain containing immature weevils of known ages. When adults were exposed to mixtures containing decreased concentrations of oxygen or increased concentrations of carbon dioxide, that of the other gas remaining as in air (about 20·9 and 0·03 per cent., respectively), the full lethal effects became apparent within 17 days, insects then alive surviving for the rest of the experimental period. Among weevils exposed for 17 days, the response was sharp, but occurred only when the gas concentrations differed considerably from normal, mortality of all stages being complete only when the concentration of carbon dioxide was as high as 40 per cent. or that of oxygen was reduced to almost 2 per cent. Adults were the most and first-instar larvae the least resistant. When adults were exposed to mixtures in which the concentration of one gas was varied and that of the other kept just within non-lethal limits, mortality did not occur until the carbon-dioxide concentration exceeded 25 per cent., and it was not complete until the concentration of oxygen fell to 3 per cent., though some mortality occurred with the oxygen concentration as high as 9 per cent.

Calculation of the concentrations of carbon dioxide and oxygen that can occur under the physical conditions of the experiments in the intergranular air of hermetically sealed grain infested by *C. granaria* showed the maximum reached by the former to be less than 17 per cent., whereas the oxygen content falls as low as 0·11 per cent., and this latter factor is therefore considered the one responsible for insect mortality. This explains the failure of earlier attempts to control grain pests by fumigation with carbon dioxide [but *cf.* **29** 380], and a test showed that up to 20 per cent. of adults of *C. granaria* survived exposure to almost pure carbon dioxide for five days. The greater susceptibility of the young larvae may, in part, be only apparent; the wall of the grain prevents gaseous diffusion to an extent that decreases as the larva continues to hollow out the contents, and the concentration of oxygen within the grain may in the early stages be considerably lower than that in the intergranular air. Concentrations of carbon dioxide as high as 27 per cent. were recorded in storage pits in Argentina, and these are attributed to the presence of insects of other species, the conditions of temperature and humidity prevailing, unequal diffusion of carbon dioxide and oxygen, or, probably, to anaerobic respiration by microflora in damp patches of grain or against the floor or walls of the pit.

Lightly infested wheat, with a carbon-dioxide value [*cf.* **32** 243] of 0·5 per cent. (corresponding to an infestation of about six weevils per lb. grain) is estimated to require 39 days for the oxygen content to fall to 2 per cent. at 25°C. when the moisture content of the grain is 14 per cent., and complete mortality will be reached within a further 17 days. Heavily infested grain with a carbon-dioxide value of 5 per cent. will require a total of 21 days. The time required for lethal conditions to be set up is directly proportional to the amount of oxygen available. An air space of 10 per cent. above the grain in the container increases it by 5 per cent., and one of 50 per cent. increases it by 75 per cent. Containers should therefore be filled as far as possible. The amount of loss due to the weevil before lethal conditions are reached is estimated at 4·7 oz. per ton, independent of the number present or of physical conditions, but if there is 50 per cent. air space in the bin, the loss is increased to 16·4 oz. per ton. This amount is still negligible, and the loss in practice will depend on the degree of air-tightness of the sealing.

In the second paper are given the results of similar tests with the small strain of *C. oryzae* (L.) [*cf.* **33** 361], the reactions of all stages of which in

general resembled those of *C. granaria*. The work was carried out at 29°C. [84·2°F.] and 72 per cent. relative humidity, which are about optimum for this weevil. In preliminary tests, the adults survived exposure to concentrations of carbon dioxide exceeding those in hermetically sealed grain for more than four weeks, which equalled the duration of the life-cycle under the experimental conditions; in general, the full effect of the exposure to reduced oxygen became apparent within 14 days, and this period was therefore selected for the further tests. When the content of carbon dioxide was maintained as in air, complete mortality occurred when the concentration of oxygen fell to almost 4 per cent., and when the oxygen content was maintained as in air, a concentration of 35 per cent. carbon dioxide was required to give complete kill. The immature stages less than seven days old were the most susceptible, and the older immature stages and the adults were about equally resistant. In tests with mixtures in which the concentration of one gas was varied and that of the other maintained within non-lethal limits, complete mortality occurred when carbon dioxide reached a concentration of 13·2 per cent. or when the oxygen concentration fell to about 7 per cent. The concentration of carbon dioxide in wheat infested by this weevil and stored in air-tight containers is estimated to reach a maximum of 16 per cent. and that of oxygen a minimum of 0·06 per cent., and it is concluded that mortality of this weevil in sealed containers is also due to lack of oxygen. It is further estimated that, at 29°C., lethal conditions would develop in 25 days in lightly infested grain with a carbon-dioxide value of 0·5 per cent., giving a maximum total of 39 days for complete mortality. This total would be 17 days for heavily infested grain with a carbon-dioxide value of 5 per cent.

Gray (H. E.). **Premix Food Packages and some chemical Treatments to reduce Penetration by Insects.**—*Tappi* **38** no. 6 pp. 329–333, 2 figs., 9 refs. New York, N.Y., 1955.

Packages of baking ingredients mixed ready for use must be resistant to attack by insects, especially while stored in shops, and suitable containers have been under investigation in Canada since 1950. The ability of insects to penetrate packages varies, and random sampling by the manufacturers of a bread mixture in shops in the United States showed that 35·9, 28·6, 14·2, 8·6 and 7·9 per cent. of the packages found infested contained *Oryzaephilus surinamensis* (L.), *Tribolium confusum* Duv., *Plodia interpunctella* (Hb.), *Dermestes lardarius* L. and *T. castaneum* (Hbst.), respectively, whereas less than 1 per cent. were attacked by *Tenebroides mauritanicus* (L.), which has been widely used for testing packages for insect penetration. A survey of chemicals that can be applied to packages to reduce insect penetration by killing or repelling the pests without danger to consumers showed that mixtures of piperonyl butoxide and pyrethrins were the most promising, and these were therefore tested, mainly against *O. surinamensis*, *Tribolium confusum* and *P. interpunctella*, in different formulations, concentrations and quantities. The results indicated that mixtures of 50, 30 or 20 gm. piperonyl butoxide with 5 gm. pyrethrins per 100 ml. concentrate, diluted 1:2 in an odourless base oil and applied by means of rollers, afforded complete protection for eight months. Greater dilutions of the concentrates were usually less effective, though the decrease was irregular, and the greatest tested (1:200) was still very effective and superior to many of the others. The higher concentrations killed the insects by contact action, whereas the lower ones repelled them. Treatment of all surfaces was required for complete protection. The addition of 0·85 per cent. of the first mixture diluted

1:10 to the glue used to seal the packages still further reduced penetration, but incorporation into varnishes and lacquers for surface treatment was ineffective. Packets treated with a proprietary preparation of allethrin and an activator were highly resistant to insect penetration, but had a persistent odour. Regardless of their inherent or added repellency, containers successfully resisted insect penetration only when they had a smooth surface and were tightly sealed.

Nuorteva (P.). **The Possibility of distinguishing the Symptoms of Injury to Wheat Kernels made by different Heteropterous Bugs.**—*Ann. ent. fenn.* **22** no. 3 pp. 120–121, 1 fig., 4 refs. Helsinki, 1956.

Since not all the Heteroptera that puncture the developing kernels of wheat cause loss of baking quality [*cf. R.A.E.*, A **43** 398, etc.], the feeding habits of *Dolycoris baccarum* (L.), *Lygus rugulipennis* Popp. and *Miris dolabratus* (L.), which are the three commonest wheat bugs in Finland, were investigated with a view to differentiating kernels attacked by them. *D. baccarum* was found to insert its mouth-parts into the kernels through the husks, whereas *L. rugulipennis* did so between the husks and *M. dolabratus* from above. As a result, *D. baccarum* distributed its punctures all over the kernels, *L. rugulipennis* mostly on the sides, and *M. dolabratus* mostly at the tip. Identification was possible from statistical examination of several hundred kernels from a sample, but not from a single puncture.

Papers noticed by Title only.

Grayson (J. M.) & Cochran (D. G.). **On the Nature of Insect Resistance to Insecticides** [a review article].—*Virginia J. Sci.* (N.S.) **6** no. 3 pp. 134–145, 1 graph, 47 refs. Richmond, Va., 1955.

Avidov (Z.) & Mohrer (I.). **Occurrence of the Olive Fly** [*Dacus oleae* (Gmel.)] **at Huldah in 1953 and its Control.**—*Ktavim* (Engl. edn.) **4** no. 4 pp. 51–59, 1 graph, 6 refs. Rehovot, 1954. [For shorter account see *R.A.E.*, A **44** 114.]

Nonveiller (G.). **Drugi prilog evropskoj bibliografiji o dudovcu.** [A second Contribution to the European Bibliography of *Hyphantria cunea* (Dru.).]—*Plant Prot.* no. 25 pp. 105–109. Belgrade, 1954. [*Cf. R.A.E.*, A **43** 174.]

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It is suggested that, before writing an article, an intending author should intimate to the Editor the title, scope and probable length of the article he has in mind.

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